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CRS Report for Congress

Ecosystem Management: Federal Agency Activities

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ECOSYSTEM MANAGEMENT: FEDERAL AGENCY ACTIVITIES

SUMMARY

Eighteen Federal agencies demonstrated their ecosystem management activities to the congressional community on March 24, 1994, as part of a two-day ecosystem management symposium convened by the Congressional Research Service at the request of the House Agriculture Committee, the House Merchant Marine and Fisheries Committee, the House Natural Resources Committee, the Senate Agriculture, Nutrition, and Forestry Committee, the Senate Energy and Natural Resources Committee, and the Senate Environment and Public Works Committee.

This report is a compilation of short papers distributed at the demonstration, describing each participating Federal agency's ecosystem management efforts. Each agency was asked to address five topics.

1. *Ecosystem Management Activities*. Explain what your agency is doing in the area of ecosystem management. Please distinguish efforts at broad policy levels and more specific program levels. If your agency has a mission statement relating to ecosystem management, please include that or summarize it. Also, if your agency has a working definition of ecosystem management, please include that as well.

2. *Cooperation and Coordination*. Discuss how your agency has cooperated with other Federal agencies. How do you coordinate your ecosystem management programs and activities with State and private efforts? Also, discuss the role of the Interagency Ecosystem Management Coordination Group in your current programs and activities in ecosystem management.

3. *Tools of Ecosystem Management*. Summarize any practical experience at your agency with automated geographic analysis tools such as geographic information systems (GIS) or Gap analyses, whether or not they will be demonstrated at the symposium.

4. *Funding Ecosystem Management*. Does your current budget structure accommodate ecosystem management? Will further implementation of ecosystem management require budget restructuring? If so, how? Do you anticipate that ecosystem management programs will be affected by changing priorities at your agency in the future? Also, address what portion and which aspects of your ecosystem management work are to be carried out within the agency by contractors.

5. *Ecosystem Management Limits and Opportunities*. Describe what your agency would like to be doing in ecosystem management but cannot do currently because of insufficient staff or legal restrictions. How does your agency plan to address these problems, and how does it envision its future role in ecosystem management, assuming these problems are addressed?

CONTENTS

INTRODUCTION 1

DEPARTMENT OF AGRICULTURE
  EXTENSION SERVICE 5
  FOREST SERVICE 13
  SOIL CONSERVATION SERVICE 23

DEPARTMENT OF COMMERCE
  NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION . 29

DEPARTMENT OF DEFENSE 39

DEPARTMENT OF ENERGY 43

DEPARTMENT OF THE INTERIOR
  BUREAU OF INDIAN AFFAIRS 51
  BUREAU OF LAND MANAGEMENT 59
  BUREAU OF MINES 65
  BUREAU OF RECLAMATION 69
  FISH AND WILDLIFE SERVICE 73
  MINERALS MANAGEMENT SERVICE 79
  NATIONAL BIOLOGICAL SURVEY 85
  NATIONAL PARK SERVICE 91
  U.S. GEOLOGICAL SURVEY 99

ENVIRONMENTAL PROTECTION AGENCY 107

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION 115

NATIONAL SCIENCE FOUNDATION 119

ECOSYSTEM MANAGEMENT: FEDERAL AGENCY ACTIVITIES

INTRODUCTION

The Congressional Research Service (CRS) convened a two-day symposium on ecosystem management on March 24 and 25, 1994 in response to requests from six congressional committees:

House Agriculture Committee;
House Merchant Marine and Fisheries Committee;
House Natural Resources Committee;
Senate Agriculture, Nutrition, and Forestry Committee;
Senate Energy and Natural Resources Committee; and
Senate Environment and Public Works Committee.

One focus of the symposium was the examination of Federal agency activities initiated in the name of ecosystem management. Eighteen agencies used displays to demonstrate their ecosystem management activities to the congressional community. As part of each display, agencies were asked to write a short paper on ecosystem management activities. These papers are reproduced on the following pages and are the agencies' assessments of their activities[1].

All but one of these Federal agencies are members of an informal group called the Interagency Ecosystem Management Coordination Group (IEMCG). Most agencies in the IEMCG participated, although space limitations at the Library of Congress precluded participation of all members. The IEMCG also mounted an interagency display. In addition, one other agency, the Extension Service in the U.S. Department of Agriculture, wrote a report on its activities that is also included.

The agencies provided informative presentations with sophisticated and interesting displays. Many of the displays involved computer simulations or demonstrations. Agencies all distributed information on many of their activities; one agency even distributed video tapes. These presentations were designed to make the congressional community aware of the amount and diversity of activities that are captured under the ecosystem management label by Federal agencies.

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[1] The Congressional Research Service did not edit the agencies' reports, with the exception of minor changes in format for editorial consistency. The inclusion of an agency's report does not reflect an endorsement by the Congressional Research Service.

AGENCY REPORTS

CRS has compiled the papers from the demonstration and display session to release the information to the congressional community as quickly as possible. Proceedings of the entire symposium will be published by the Senate Environment and Public Works Committee, in late summer 1994. This report on agency activities may prove useful as the appropriations and authorization committees consider various legislative proposals during the remainder of the 2nd Session of the 103rd Congress.

Each agency was asked to address five topics. These topics were selected so that each agency could describe current activities and future directions in ecosystem management.

1. *Ecosystem Management Activities.* Explain what your agency is doing in the area of ecosystem management. Please distinguish efforts at broad policy levels and more specific program levels. If your agency has a mission statement relating to ecosystem management, please include that or summarize it. Also, if your agency has a working definition of ecosystem management, please include that as well.

2. *Cooperation and Coordination.* Discuss how your agency has cooperated with other Federal agencies. How do you coordinate your ecosystem management programs and activities with State and private efforts? Also, discuss the role of the Interagency Ecosystem Management Coordination Group in your current programs and activities in ecosystem management.

3. *Tools of Ecosystem Management.* Summarize any practical experience at your agency with automated geographic analysis tools such as geographic information systems (GIS) or Gap analyses, whether or not they will be demonstrated at the symposium.

4. *Funding Ecosystem Management.* Does your current budget structure accommodate ecosystem management? Will further implementation of ecosystem management require budget restructuring? If so, how? Do you anticipate that ecosystem management programs will be affected by changing priorities at your agency in the future? Also, address what portion and which aspects of your ecosystem management work are to be carried out within the agency by contractors.

5. *Ecosystem Management Limits and Opportunities.* Describe what your agency would like to be doing in ecosystem management but cannot do currently because of insufficient staff or legal restrictions. How does your agency plan to address these problems, and how does it envision its future role in ecosystem management, assuming these problems are addressed?

These papers are not intended to be definitive explanations of all agencies' activities and efforts, but rather to provide an overview of the major efforts and an indication of current agency thinking and direction. To assist readers who wish to learn more about the activities of any of these agencies, or of the IEMCG, each paper concludes with an agency contact and phone number.[2]

COMMENTS ON THE PAPERS

Many Federal agencies appear to be very aggressive in redirecting current efforts or initiating ecosystem management activities. These efforts and activities are diverse in scale, focus, institutional relationships, goals, and accomplishments. When they are viewed together, two themes seem most common. One is improved communication and coordination. Improvement is based on building new partnerships, sharing information, and reaching agreements or definitions for key terms and data collection. The second is trying to improve the condition of resources, which some are calling protection of biodiversity. These efforts might grow out of working to protect individual species and their habitats, restoring ecological processes and ecosystem services, or restoring degraded resources in an area. Agencies have listed many examples of these approaches in these summaries.

The current focus seems centered on the communication and coordination aspects of ecosystem management, perhaps because results here are visible far more quickly than for significant changes in resources. Improved resource conditions are decades away in many cases, even if ecosystems are managed in a scientifically sound and programmatically consistent manner. And these improved conditions are hard to measure, because ecosystems involve so many interrelated components, but the crucial variable is the health of the overall system rather than any single component. The IEMCG plays a key role in these efforts by supporting activities to improve communication and coordination and to change resource conditions. In a recent brochure, its listed efforts included:

- forming committees and working groups to address the complex of issues arising as agencies adopt ecosystem management;
- facilitating the standardization of data sharing techniques and ecosystem mapping techniques;
- establishing general implementation guidelines on ecosystem management for assimilation by participating agencies;
- identifying training needs and instituting collaborative training programs;
- adopting a Memorandum of Understanding among participating agencies to formally establish the Coordination Group and its role;
- serving as a resource to ensure each agency is current with ongoing research and information including legislative concerns;
- facilitating the adoption of standard terminology for participating agencies to use in ecosystem management and relevant aspects of research and operation;

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[2] Please note that responsibilities and phone numbers change with time. Also, these contacts may be only a starting point, and you may be referred to others for assistance.

- maintaining an education and outreach component; and
- encouraging existing and new partnerships for management on an ecosystem basis on a multi-agency basis.

These papers also illustrate the wide variety of missions by reporting agencies. The agencies responsible for Federal lands and the resources on those lands have a very different mix of efforts than the agencies that deal with resources that are primarily on private lands. Some agencies deal more with the tools of resource analysis and with the development of resource information while others are more interested in the actual management of resources. These differences in missions are cause for a remarkable diversity in the approaches taken, in the reasons for interest in ecosystem management, and in the ways that agencies have integrated these efforts with ongoing activities and approaches to problem solving or resource management.

The intensity of the effort is also striking. All these agencies are devoting significant resources, both staff and financial, to this effort at a time of budget constraints and Federal downsizing. But the benefits of this approach, as they are defining it, seem to outweigh any costs, assuming successful implementation. Equally striking is the faith that the many government employees who participated in this demonstration appear to place in an ecosystem approach as a more rational way of serving the public good. One of the more difficult challenges for these agencies will be to maintain this intensity in continuing to work together successfully toward a consistent approach over time and in the face of changes in priorities, authorizations, and appropriations from year to year.

DEPARTMENT OF AGRICULTURE
EXTENSION SERVICE

ECOSYSTEM MANAGEMENT ACTIVITIES

The U.S. Department of Agriculture (USDA) Extension Service conducts educational programs to bring about changes in people's knowledge, attitudes, and behavior relative to ecosystems:

Private Lands

Research based educational programs are conducted by the Extension Service, USDA, through the Nation's 74 Land-Grant Colleges and 3,150 county Extension offices. These programs motivate millions of farmers, forest owners, and ranchers to voluntarily adopt aspects of sound ecosystem management. New for 1994 are Renewable Resources Extension Act (RREA) forest ecosystem grants, which are funding programs to motivate private forest owners to practice good stewardship.

Timber Harvesting

Extension trains timber harvesters to be environmentally aware through its ongoing Logger Education to Advance Professionalism Program (LEAP). LEAP grants provide the impetus for educational programs which motivate loggers to undertake environmentally sensitive logging practices. Such practices benefit the future ecosystem of the harvested area.

Professional Skills

The explosion of new concepts, policies, and scientific knowledge has left many natural resource professionals behind. Practicing professionals as well as university professors and researchers need the continuing education in ecosystem management that Extension provides through its Land-Grant Colleges and Universities. The new knowledge spreads from professionals to all those students, businesses, landowners, managers, and others with whom those resource professionals have contact. Professionals who have resource management skills in one narrow subject benefit from continuing education in a related subject, or in a process skill such as learning how to conduct public issues education relative to sensitive and often highly polarized subjects such as ecosystem management, sustainability, wetlands management, and endangered species.

Public and Youth

Educational programs for the public and youth lead to a better understanding of ecosystem management. Users become aware of practices they can undertake to sustain ecosystems. Their understanding can lead to increased public support for ecosystem management. Youth have always been an important audience for Extension through its 4-H and other youth education programs. These future leaders will use their knowledge of ecosystem management to redirect our Nation toward a sustainable future.

Extension's mission relative to ecosystem management is contained within our mission statements for our base program in Natural Resources and Environmental Management (NREM), and our mission statement for our Forest Resources Action Plan (FRAP).

- To educate a diverse people to make decisions and take actions to improve the quality, productivity, and sustainability of natural resources.
- To educate a diverse people to make decisions and take actions to improve the quality, productivity, and sustainability of the Nation's forest resources.

Extension agrees with the definition of ecosystem management proposed by the Interagency Ad Hoc Team assembled by the Forest Service on February 28, 1994:

> The integration of ecological principles, and economic and social factors, to manage ecosystems to safeguard ecological sustainability, biodiversity, and productivity.

COOPERATION AND COORDINATION

Extension Service at the Federal level participates in the USDA Ecosystem Management Ad Hoc Team. We also use memorandums of understanding and cooperative agreements, as appropriate. State and county Extension Services cooperate with the appropriate agencies at those levels.

ES-USDA is a member of USDA's Ecosystem Management Ad Hoc Team, Forest Service's Stewardship Committee, National Urban Forestry Advisory Committee, Logger Education to Advance Professionalism Committee, and Agriculture Geographic Data Committee. We have frequent contact with the Forest Service, Soil Conservation Service, U.S. Fish and Wildlife Service, Bureau of Land Management, the National Biological Survey, and EPA. Staff serve on numerous interdepartmental, interagency and private sector committees such as the National Council on Private Forests, the Forest Research Mandate for Change Implementation Team, the American Forest and Paper Association's Research Committee, the National Association of Conservation District's Forestry and Urban, Community and Coastal Resources Committees, the International Association of Fish and Wildlife Agencies Committees, and the Great Plains Agricultural Council. Our role with regard to the Interagency Ecosystem Management Coordination Team would be through our representation on USDA's Ecosystem Management team. We also participate as individuals in our respective professional societies.

TOOLS OF ECOSYSTEM MANAGEMENT

Extension Service at the Federal level is represented on the Agriculture Geographic Data Subcommittee. We do not maintain our own Federal GIS system because our agency does not collect data nor manage Federal land. State Extension Services offer educational programs to a wide variety of GIS users. Three examples involve education on use of GIS to improve resource management decisions, to model the ecology of a riparian system, and to accurately apply farm inputs:

- Rhode Island teaches policy makers and natural resource professionals to make resource management decisions using GIS and Global Positioning Systems (GPS). Municipal officials use these new technologies to develop and implement local, site-specific nonpoint source pollution management strategies. A GPS reference base station in Rhode Island permits more accurate field location. Ecosystem management information is included as it becomes available.

- State and County Extension Specialists in North Carolina use GIS for ecological modeling of riparian systems in Gaston County. GIS is used to trace pollutants in order to learn how to reconstruct the ecology of Long Creek and restore water quality (Pages 592-597, Proceedings Computers in Agriculture 1994, Florida Cooperative Extension Service, "Ecological Modeling of Riparian Systems Using a GIS", by White, Jennings, and Harman).

- Extension provides information on the use of GPS and GIS for "precision-farming". GPS permits custom application of fertilizers or pesticides to areas as small as one-thousandth of an acre through accurate positioning of equipment and automatically controlled application rates. This results in inputs that are exactly appropriate to the situation, with obvious benefits to the environment.

FUNDING ECOSYSTEM MANAGEMENT

Extension was authorized, as the outreach arm of the Department of Agriculture, by the Smith-Lever Act of 1914. This legislation provided for a Cooperative Extension Service to be created at each State's land-grant university, with supporting field offices in nearly every county. Since its inception, the Extension structure has been conducting educational programs for farmers, homemakers, youth, and others.

The principle Federal source of funds available to State Extension Service is $273 million (FY94) in Smith-Lever 3b&c. These funds, which require a 50-50 match, are distributed by formula to State Extension Services to "diffuse among the people of the United States useful and practical information on subjects relating to agriculture, home economics, . . .etc." Legislative direction is quite flexible, and thus educational programming in support of ecosystem management is a judgment decision at the State level. Extension Service-USDA exerts its influence over programs through: (1) the plan of work approval process, and (2) the promotion of national initiatives in support of contemporary issues. Through this process the States have the maximum opportunities of developing and delivering programs in support of local, State and national issues.

Smith-Lever 3d and other authorizations are also available to States. For example, Extension's FY 1994 budget contains twelve line items under Smith-Lever 3d, plus the Renewable Resources Extension Act (RREA). Smith-Lever 3d and the RREA funds are intended for very specific programs, some of which could be related to ecosystem management. They are:

Pest Management	$8.459 million
Water Quality	$11.234 million
Sustainable Agriculture	$2.963 million
Renewable Resources Extension Act	$3.341 million

The Renewable Resources Extension Act (RREA) is the most used line item for ecosystem management. The purpose of RREA is to provide for "an expanded and comprehensive extension program for forest and rangeland renewable resources". Ecosystem management clearly fits the intent of RREA and in that regard Extension distributed $3.341 million of RREA funds to the States in FY 1994.

Although some renewable resources education was funded prior to RREA using Smith-Lever 3b&c funds, these programs have grown in emphasis thanks to the 1978 Renewable Resources Extension Act (RREA), which authorized $15 million. Congress provided $2 million in line-item funding, beginning in 1982, with some increases since then. RREA funds average less than $90,000 per State which is regarded as modest by many of Extension's public and private partners. States have been able to use RREA funds to leverage additional funds. RREA funds increased to $3.341 million in FY94, of which $500,000 was used to fund 11 multi-State, regional, or national forest ecosystem grants.

Through Federal appropriation, State and local match, and other leveraging Extension is able to report the following annual renewable resources accomplishments:

- 100,000 contact hours of continuing education to 25,000 natural resource professionals;
- 50,000 teachers trained in environmental science;
- 2.3 million private non-industrial landowners assist;
- 54 million acres of improved forest and range land management;
- $300 million of increased landowner revenue from forestry, range, and wildlife management practices;
- 50,000 forest industry worker assist;
- $10 million in savings through improved forest industry efficiency; and

- A recent bibliography of Extension wildlife, fisheries, and forestry educational materials list 1,800 publications and videotapes.

(State-by-State accomplishments are given in "Renewable Natural Resources Education -- A Report to Congress on the 1991-1995 Renewable Resources Extension Program" and "Extension Accomplishments Reported for Natural Resources Programming During the Fiscal Years 1989-1991", compiled by Loren R. Larson, II).

Funding and Results of LEAP

LEAP is a successful pilot program which is demonstrating that timber harvesters can be taught to log in an environmentally aware manner. LEAP was funded for three years (1992-1994) for $300,000. Logging is the most visible, and can be the most disturbing single act that affects forest land, and therefore can have a significant influence on future ecosystems. Ecosystems, especially on private lands, will benefit from LEAP as this pilot program is duplicated and implemented throughout the system.

Funding and Anticipated Results of RREA Forest Ecosystem Grants

Forest ecosystem grants totalling $500,000 went to eleven separate proposals, most of which were for multi-State or regional education projects. An additional $1 million in proposals that would have covered additional States could not be funded. Titles of the grants are:

- Arizona/New Mexico: Ecosystem Management Education for Rural Communities through Multi-Interest Involvement;
- Connecticut/Massachusetts: Implementing Ecosystem Management in the Connecticut River Watershed;
- Georgia (Southern Region): Educational and Collaborative Opportunities for Southern Forest Ecosystem Management;
- Idaho/Montana/Oregon/Washington: Implementing Ecosystem Management on Pacific Northwest NIPF Lands;
- Indiana/Illinois/Kentucky/Missouri/Ohio:Central Hardwood Ecosystem Continuing Education Cooperative;
- Minnesota: Ecosystem Management on Private Lands in the Lake States;
- New Hampshire (Northeastern Region): Northeast Regional Conference on Forest Ecosystem Management;
- Oklahoma/Connecticut/Minnesota/Oregon/Virginia: Ecosystem Management Approach to Managing NIPF Lands, A National Videoconference;
- Oregon (Western Region): Ecosystem Management: Concepts and Implementation;
- South Carolina/Indiana/Utah: Forest Ecosystem Management: Assessing Clientele and Targeting Educational Efforts; and
- Virginia/Alabama/Tennessee: Bringing Ecosystem Management Concepts to Private Universities in the South;

The FY94 forest ecosystem grants represent Extension's contribution to the first year of a multi-year, multi-agency budget initiative of the Administration in forest ecosystem management. The Forest Service and the Cooperative State Research Service are cooperators in the Administration's initiative and received funds for ecosystem management research. Extension needs to continue to conduct educational programs in all States which translate research results to useful information for landowners, resource professionals, resource vendors, and the general public. The end result is that owners of private land will be able to understand and apply ecosystem management on their lands. Collectively, they own nearly two-thirds of the land base in the lower 48 States.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

Staff ceilings and legal restrictions do not limit Extension's ecosystem management activities. The major restriction is adjusting and establishing priorities. Part of this adjustment is being addressed through the budgeting process and part through the abolishment of old programs in favor of new emphases.

Extension Service-USDA's role is to provide funds and program coordination to State and county Extension Services. Universities and counties can generally add staff in response to permanent funding. Temporary, or "soft funding" promotes the use of contractual services and graduate students. Through these processes, universities are able to provide quality services in support of contemporary issues without adding full-time staff.

Ecosystem management is an appropriate topic for Extension. The Smith-Lever 3b&c mandate is very broad, and the Smith-Lever 3d or RREA funding authority could be used to assure that additional funds are targeted to ecosystem management.

Extension envisions playing a significant role in ecosystem management for education is regarded as a key stimulant to the adoption of ecosystem management concepts on private lands. The challenge is reaching the multitude of owners and users. Recent surveys suggest that this audience consists of seven million owners and managers, five million 4-H youth, and over 108 million users of the Nation's private forest, range, and aquatic resources, (hikers, campers, hunters, fishermen, etc.).

SUMMARY

Extension education programs in many subjects over many years have resulted in significant benefits to the Nation when its citizens know how to make better decisions.

Extension is well-positioned to expand its ecosystem management educational programs. Extension education can: (1) motivate private landowners to incorporate ecosystem management in their objectives, (2) assist private landowners to modify timber and forage production systems in favor of sustaining ecosystems, (3) improve the competence of natural resource professionals to manage and sustain ecosystems, and (4) increase awareness of ecosystem management by the public and youth. Ongoing education programs on ecosystem management are dynamic and cost-effective. Expanded programs are expected to be equally dynamic, cost-effective and responsive to the shift in management direction for public and private lands.

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DEPARTMENT OF AGRICULTURE
FOREST SERVICE

ECOSYSTEM MANAGEMENT ACTIVITIES

The Forest Service mission statement is: "Caring for the Land and Serving People". The Forest Service understands ecosystem management to mean using an ecological approach to achieve the management of national forests and grasslands by blending the needs of people and environmental values in such a way that national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems. The Forest Service has developed guiding principles to implement its mission statement "Caring for the Land and Serving People," one of which is to use an ecological approach in assessing and managing land and related resource values in a sustainable manner.

The Forest Service envisions ecosystem management as a holistic approach to natural resource management, moving beyond a compartmentalized approach that focuses on the individual parts of the forest. It is an approach that steps back from the forest stand and looks at the forest landscape and its position in the larger environment in order to integrate the human dimensions of natural resource management. Its purpose is to achieve sustainability of all resources.

Scientific Foundation

The scientific basis for ecosystem management is provided by Forest Service Research and cooperating scientists from other institutions. Forest Service Research is focusing its resources on developing and providing scientific and technical knowledge to improve the productivity, health, and diversity of forests and grasslands. An enhanced scientific underpinning is fundamental to taking an ecosystem approach to managing our natural resources on a sustainable basis.

Policy Level Actions

In June 1992, the Forest Service announced ecosystem management as the framework for managing the national forests and grasslands. This announcement followed a two-year experiment in ecological approaches to management that we called "New Perspectives". Although Ecosystem Management is a new land management philosophy, the Forest Service is well positioned to develop ecological approaches building upon nearly 100 years of land management experience and a broad array of expertise including Forest Service Research scientists and field-level resource professionals. This effort is supported by the direction provided by the Organic Act, the Multiple Use-Sustained Yield Act, the National Forest Management Act, and the forestry provisions of the 1990 Farm Bill.

To carry out ecosystem management, Forest Service land managers are directed to understand the structure, function, and variability of ecosystems and to develop appropriate site specific management activities. Because of its complexity, ecosystem management requires an accelerated scientific effort and the efficient incorporation of science into on-the-ground projects. It also depends on grass-roots participation in decision-making and partnerships to achieve shared goals.

The Forest Service has established a Reinvention Team as part of the Vice-President's National Performance Review that will recommend organizational changes to meet the needs of ecosystem management.

The Forest Service has adopted an ecological unit framework to provide a scientific basis for ecosystem management. The framework is a classification and mapping system for stratifying areas into ecological units that have common biological and environmental factors. These factors include climate, physiography, water, soils, air, and natural communities. We have been working closely with other Federal agencies as we developed this framework.

In September 1992, we directed our field units to develop action plans for the implementation of ecosystem management.

We have identified changes that need to be made to our regulations to streamline our land management planning process and to base it upon ecosystem management principles. We will propose these regulatory changes in May 1994.

We have completed some major regional ecosystem assessments and are beginning some others. An example was our participation in the interagency Forest Ecosystem Management Assessment Team (FEMAT) report for the Pacific Northwest and northern California spotted owl forests. We also prepared the Eastside Forest Ecosystem Health Assessment for eastern Oregon and Washington. Also being completed by the Forest Service and Bureau of Land Management is a strategy for protecting the habitat of Pacific salmon and steelhead (PACFISH) for Oregon, Washington, California, Alaska, and Idaho. Another is just beginning for the Sierra Nevada in California.

We are developing a national strategy for monitoring and evaluation as an integral part of ecosystem management.

Program Level Actions

Over the past several years, the Forest Service has conducted numerous experiments, demonstrations, and pilot efforts evaluating practices and activities that support an ecosystem management approach.

At the program level, the Forest Service is emphasizing the role of fire management, forest health strategies, social impact assessment training, and a support framework to address decisionmaking across multiple spatial and temporal scales.

We have numerous program level examples of ecosystem management on national forests, in our research programs, and in cooperation with other landowners in our State and Private Forestry program. These examples include: restoration of sand pine-scrub oak ecosystems eliminated by development in Florida; restoration of eastern Washington and Oregon forests affected by fire suppression and insect outbreaks; and restoration of spruce and hardwood ecosystems in Alaska following epidemic spruce beetle infestations. Rangeland projects include: the Yavapai Ecosystem Management Project in Arizona; Negrito Project in New Mexico; Taylor/Priest Grazing Allotment Project in Colorado.

Other projects emphasize special management areas: wetlands of Alaska's Copper River Delta; Butte Valley National Grassland in California; and old-growth forests of the Carson National Forest in New Mexico.

Each of these programs demonstrate not only aspects of improved ecological approaches to resources but also the human aspects of ecosystem management. Grass roots participation as well as scientists and managers working side by side in the development of these programs are critical elements.

COOPERATION AND COORDINATION

Interagency Cooperation

The Forest Service is an active member of the Interagency Ecosystem Management Work Group which carries on the day-to-day work of the Office of Environmental Policy's Interagency Ecosystem Management Task Force. The Task Force was established to implement an ecosystem approach to environmental management.

The Forest Service is co-founder and an active participant of the Interagency Ecosystem Management Coordination Group and the Department of Agriculture's Ecosystem Management Coordination Team. Both groups are designed to share information, coordinate projects of interest across agency lines, and provide a forum for the development of new concepts in ecosystem management.

The Forest Service is active in exchanging personnel with other agencies to promote understanding, support, and acceptance of ecosystem management programs. Examples include the President's Commission on Sustainable Development; the National Biological Survey to participate in program and policy development; coordination with the Bureau of Land Management (BLM) on rangeland reform; close work with the State Department to develop criteria for sustainable development; partnerships with the Environmental Protection Agency, the BLM, and the National Association of State Foresters among others, to develop and implement Forest Health Monitoring.

The Forest Service is participating on a coordinating committee with the BLM, Fish and Wildlife Service, National Park Service, Department of Defense, and the Nature Conservancy to promote the role of Research Natural Areas in ecosystem management. The Forest Service is also working with the BLM to develop parallel land management planning regulations which will incorporate the same principles of ecosystem management. This effort will greatly improve the coordination of plans and activities on both National Forest System lands and lands administered by BLM.

State and Private Landowner Cooperation

Ecosystem management includes a commitment to work with even more partners than we've had in the past. Because ecosystems cross boundaries, many Federal, State, and county agencies; Tribal governments; private landowners; community leaders; and corporate foresters are interested in ecosystem management. We recognize the sensitivity of private property rights and the questions about how ecosystem management can be implemented across property boundaries. Our objective is to provide technical and financial assistance to Federal and State land managers and to nonindustrial private landowners. Through this effort, we can help land managers and landowners meet their objectives for their land by encouraging the use of sound ecological approaches.

Longstanding partnerships with Federal land managers, State foresters, nongovernment organizations, local officials, and landowners have developed strong, successful working relationships. These relationships foster ecosystem approaches at all levels to achieve sustainable forests, as well as sustainable communities.

The State foresters, working independently and through the National Association of State Foresters, are major partners in delivery of State and Private Forestry programs to the field level. Ongoing coordination is maintained with national associations representing local community groups, such as the National Association of Counties and the National Association of Conservation Districts.

Examples of State and Private Forestry programs that provide an excellent opportunity to inform, involve, and coordinate ecosystem approaches are:

- Forest Stewardship program provides technical and financial assistance to nonindustrial forest landowners to encourage good stewardship and wise use of forest resources;
- Forest Health program supports resource management through cooperative monitoring and evaluation of forest health; and through prevention and suppression of forest pest outbreaks;
- Fire Management program works cooperatively to manage the effects of fire across the landscape;

- Forest Legacy program seeks to protect ecologically significant lands from uncontrolled development through purchase of easements from willing landowners;
- Rural Community Assistance program help to strengthen the capacity of rural communities to develop locally led, sustainable economies consistent with ecosystem management principles; and
- Urban and Community Forestry program provides assistance to communities to manage urban forest resources.

International Cooperation

Because ecosystems and related resource values extend beyond national boundaries, the Forest Service is participating in an international forum to develop criteria for sustainable forest and rangeland management. The Forest Service is also working with the U.S. Agency for International Development, the Peace Corps, and other international agencies to provide technical assistance, training, and cooperative research for sustainable management of the world's forest resources. Examples include, chairing the Committee on Reforestation at the International Tropical Timber Organization meeting; participating in the Global Forest Conference in Indonesia; the U.S.-Japan Cooperative Program where an agreement was signed to increase technical assistance to developing countries; and assisting in the drafting of an agreement for the International Convention on Desertification.

TOOLS OF ECOSYSTEM MANAGEMENT

Geographic Information Systems (GIS)

To meet forest planning and implementation requirements, GIS is being used to increase the data and analysis accuracy, and to reduce the time needed for analysis. Approximately 334 Forest Service sites have some type of interim GIS system. GIS capability has greatly enhanced our ability to assess and develop alternative scenarios for activities that have the potential to affect the environment.

The following are a few examples of the types of analysis being performed by the units using interim GIS and other supporting technology in the Forest Service:

- Forest Plan monitoring and maintenance;
- Assessing timber salvage recovery options and impacts related to resources management after a natural disaster;
- Wildlife habitat mapping, including potential endangered species habitat analysis;
- River corridor analysis;
- Landscape analysis; and
- Watershed analysis including soil stability analysis and wetlands assessment.

Gap Analysis

The Forest Service is a key cooperator in supplying information for Gap Analysis, an ecosystem assessment designed to provide critical information in order to conserve native plant and animal species and communities. It is being used to implement conservation strategies for these species and communities. The first assessments have been completed in many of the Western States.

Other Technology

Remote Sensing

The Forest Service has been using remote sensing methods for the detection and characterization of natural resources since the 1930's. Remote sensing methods are used for the interpretation of aerial photography for timber inventory, stand vigor, and volume, mapping of insect and disease areas, fuels management, land line surveys, and mapping to support GIS.

Image Processing

The Forest Service has been using image processing since the 1970's. The Forest Service has a number of image processing centers for processing satellite imagery to serve as a source of vegetation layers for GIS. Satellite data are used to create integrated resource inventories, to map vegetation, to detect change, and to delineate critical wetlands and wildlife habitat.

Global Positioning System (GPS)

The Forest Service is using GPS for environmental mapping, timber cruising, rangeland and wildlife habitat mapping, fire boundary locations, and other resource mapping needs. GPS is also used for map editing, and has also assisted in the development of GIS data bases. The Forest Service has approximately 500 GPS units throughout the agency, and currently administers 20 base stations, with more base station installations planned in the near future.

Future Imaging Technology

The Forest Service is using airborne video to quickly and efficiently update data bases for difficult-to-photograph locations such as southeastern Alaska. Video technology and the development of a portable aerial video system are now coming on line in the Forest Service. A system referred to as the "Fire Mouse Trap" is being used for mapping fire perimeters and to identify "hot spots" within the fire perimeter. This information can be relayed to a GIS workstation at the fire base headquarters determining fire suppression needs.

A discussion of the technological tools is incomplete without considering the context for their use and the information available by GIS technology. Two efforts underway address these issues.

Decision Support Framework

We have established an agency-wide effort to establish a Decision Support Framework for ecosystem management that will provide both formal and informal decision support policy and procedural guidelines. This will include a series of analytical tools and decision support systems, and maintenance for those tools and systems. It will also include training and education focusing on ecosystem management principles, decision support, analytical methods, and the use of software tools.

Information Management

While technology such as GIS and remote sensing will be invaluable for ecosystem management, one essential element of any technology or analytic methodology is the availability of current inventory information for which there are recognized, well-defined data standards. We have recognized a need to address the integrated inventory of resources and the social, economic, and ecological conditions and trends at multiple spatial and temporal scales.

FUNDING ECOSYSTEM MANAGEMENT

Increased competition for resource uses and values, changing social views, requirements of laws and regulations, and the need to focus on the long term sustainability of ecosystems have required natural resource management to become more holistic and integrated.

Although the Forest Service can implement ecosystem management under the current budget structure, the present structure does have complexities that make implementation considerably more difficult. A number of modifications to the current budget structure have been proposed to facilitate implementation of ecosystem management. This proposal is seen as a first step in implementing recommendations of the National Performance Review and will make ecosystem management easier to plan, accomplish and monitor. Additional proposals for budget restructuring will be implemented as further experience is gained using an ecosystem management approach.

The current budget structure evolved in response to highly functional resource management programs which parallel constituent groups. The highly detailed budget structure establishes fiscal controls on the input side of management through numerous budget line items. This structural detail has resulted in extremely functional, costly, and complex accounting and reporting systems that hamper the agency's ability to implement the highly integrated resource approaches needed to support ecosystem management. Extremely limited reprogramming opportunities do not allow managers the ability to adjust to rapidly changing conditions. Budgets prepared two to three years in advance of program execution often face conditions, costs, and issues that were not predicted during original formulation.

Therefore, the Forest Service has proposed simplifying and consolidating the number of items defined in the budget structure for Fiscal Year 1995. The agency has proposed reducing main appropriations from 13 to 8 and funding line items from 72 to 42. This will simplify accounting, increase flexibility, and reduce the highly functional nature of programs. The Forest Service is also proposing line items that differentiate strongly between operations, maintenance, and capital investment. A specific line item has been requested to recognize Ecosystem Planning, Inventory, and Monitoring. In addition, reprogramming authority has been requested to allow movement of up to 15 percent of each line item without prior approval, as opposed to the present constraint of 10 percent or a maximum of $250,000.

The Forest Service will explore additional budget restructuring as more experience is gained with budgeting and implementing ecosystem management. Given the state of understanding gained to date, we believe the restructuring proposal for FY 1995 is the necessary first step to provide support and flexibility for implementing ecosystem management.

Ecosystem management is the main focus for the Forest Service. Priorities have been and will continue to be shifted to ensure that actions needed to support ecosystem management are provided the necessary resources. The Forest Service is moving ahead as rapidly as possible to organize the testing and experimentation of ecosystem management over the last several years into a consistent agencywide approach.

About three percent of the Forest Service's ecosystem management work is being completed by outside contractors. These activities are primarily information collection and synthesis.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

We are looking at several areas where we will need to change our current policies to implement ecosystem management. There may be areas where changes in our existing statutory framework would be desirable. We do know that we will need to change our regulations to streamline our land management planning process and to base it upon ecosystem management principles. We plan to submit these proposed changes in 1994.

The Forest Service operates under a number of natural resource laws and the Forest Service, with the Office of General Counsel, is reviewing these existing laws to see if there are ways to implement ecosystem management more efficiently.

The Forest Service will require that all processes and activities will involve the public and other cooperators throughout the implementation of ecosystem management. The Federal Advisory Council Act (FACA) of 1972 (P.L. 92-463) poses a challenge in developing this full public participation. We have asked the

Office of General Counsel to assist us in complying with the act and still conduct an extensive public participation program.

The Forest Service faces challenges similar to other Federal agencies with declining budgets and staff. The development of techniques to support ecosystem management and agency-wide implementation require significant adjustments in essential information, analytical tools, planning processes, field actions, and monitoring activities. This necessitates adjustments in workforce skills and institutional processes. Based on the Reinvention Team's report and a continuing evaluation of ecosystem management skill needs, the Forest Service will address staffing adjustments by retraining some existing employees and emphasizing ecosystem management skills in the hiring of new employees. Presently, we are sharing critical skills between Forest Service units and by assignments from other agencies and organizations.

The Forest Service intends to play a leadership role in fully developing an ecosystem management approach for managing resource values and human interactions. This role will be a highly collaborative one with other agencies, organizations, universities and interest groups. The short term future is one of continued development of essential tools and techniques to support ecosystem management. The agency has been deeply involved in pilot projects and experimentation for several years and is shifting toward consolidating the best available understanding from these efforts and building a consistent agency-wide approach. There is a continuing focus on developing or accumulating the latest and best available knowledge about resource values and human interactions. The Forest Service is moving ahead with an ecological approach that focuses on long term sustainability of the environment, economies, and communities. While many issues will remain highly controversial, ecosystem management will provide a better basis through which to view and understand these issues and to develop sustainable solutions.

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DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

ECOSYSTEM MANAGEMENT ACTIVITIES

Ecosystem management is one of 6 major initiatives of the Soil Conservation Service's (SCS) Strategic Plan. To carry out this initiative, SCS has developed an action plan.

SCS has defined its ecosystem management role in terms of ecosystem-based assistance to resource managers (land owners and users). SCS is not a land managing agency. Our programs are delivered to landowners, users, and decision makers through Soil and Water Conservation Districts and other cooperating entities. SCS field personnel provide science-based technical assistance that provides information to clients so that they can practice effective ecosystem management. SCS ecosystem-based assistance:

- focuses on ecological principles rather than only on specific resources;
- is consistent with the need to achieve sustainable use and development of the Nation's natural resources;
- is systems-oriented, rather than single-resource focused;
- recognizes that people are part of the ecosystem; and
- conforms to the way the world is arranged -- as interrelated ecological, social, and economic systems.

SCS ecosystem-based assistance to clients uses and builds upon the SCS planning process and the SCS Field Office Technical Guide and other technical handbooks and manuals. SCS will utilize a watershed (hydrologic unit) or other geographical area to identify community concerns and needs based on impaired ecosystems and their resources and on opportunities for ecosystem enhancement. Ecosystem concerns and opportunities will then be expressed in ecosystem level plans that can be translated into individual land user plans.

SCS task forces currently are:

- assessing training needs;
- assessing training adequacy and developing courses that address deficiencies;
- assessing workload and task complexities;
- developing ecosystem quality indicators, e.g., soil quality, water quality, air quality, and ecosystem health;
- developing technical planning and evaluation tools;
- developing an ecosystem-based planning framework;
- identifying watershed and/or other geographic planning areas; and
- coordinating activities listed above with other agencies, entities, and groups. This will include alliance development with local support groups and stakeholders.

Coordination of training with other Federal agencies is underway with the purpose of achieving increased efficiency and cost savings. Soil and water quality indicator development is also proceeding through interagency task groups and through the USDA Resources Conservation Act process. Outputs from these groups will be used to focus supplemental training activity, to direct hiring of persons with new and needed specialties, and to help guide reorientation of staff and organization.

Ecosystem-based assistance requires a delivery mechanism and organizational framework that will allow functional boundaries to be established that account for socioeconomic, political, and legal constraints. Ecosystems can be delineated in time and space based upon specific criteria. Subsystems can be defined that address processes, inputs, and outputs. This ability to conceptually and functionally nest ecosystems within ecosystems offers tremendous flexibility. One convenient method of nesting is along defined hydrologic boundaries. Within this framework ecosystems can be nested: sub-fields within fields, fields within farms/ranches, farms/ranches within watersheds (or subwatersheds), watersheds within ecoregions. SCS will use this approach, when appropriate, as a framework for analysis of ecosystem conditions and for delivering technical and financial assistance to our clients.

This operational model has been embodied in an SCS strategy document entitled " The SCS Water Management Action Plan" and in a complementary document, "The Watershed Approach to Nonpoint Source Pollution Prevention and Control". Although the latter document focuses on one facet of outputs from a watershed approach to ecosystem management -- water quality improvement -- the approach is a good vehicle to bring agency and public involvement to bear on all resource issues.

Ecosystem-based assistance for the management of natural resources is defined in the SCS Action Plan as the application of appropriately integrated ecological, economic, and social factors through the SCS planning and assistance process in order to maintain and enhance the quality of the environment to best meet our current and future needs.

COOPERATION AND COORDINATION

At the national Federal level, SCS participates on the White House Ecosystem Management Work Group, the Interagency Ecosystem Management Coordination Group, initiated and co-chairs the U.S. Department of Agriculture (USDA) Ecosystem Management Ad-hoc Team, and a Forest Service (FS)/SCS work group. The USDA team, consisting of 9 agencies, has developed draft definitions and policy and will help its member agencies coordinate research, projects and related activities. The FS/SCS work group is collaborating on training and many projects, including ecosystem assessments and geographical information systems. Our role with the interagency team has been one of information exchange and preparation of a set of keywords that will facilitate dialogue on this issue.

SCS' strengths are in coordinating ecosystem management-related programs and activities among interested parties and in its technical and planning assistance capabilities. Our daily activity involves Federal, State and private sectors. SCS provides technical assistance in cooperation with conservation districts established under State law. These districts are locally-elected representatives. Almost all SCS conservation work is accomplished with districts, private landowners, and organizations. In recent years, SCS has met community needs for a more sustainable resource approach by using a consensus-building process called Coordinated Resource Management Planning. In this process, all stakeholders, representing many different interests and organizations, are invited to the table to address various resource and socioeconomic concerns. Action is taken when consensus is reached. Some examples of this collaborative process include:

- Greenville, Plumas County, California - where many different Federal, State and private interests are working together to diversify their economic base formerly dependent on timbering; improve fish habitat; reduce stream bank erosion which is destroying rangeland, threatening schools and businesses, and lowering the water table; and reduce sediment clogging the hydroelectric dam. SCS is assisting with all these objectives.

- Malpais-Borderlands Project, Arizona and New Mexico - where ranchers, Federal agencies, the Nature Conservancy, and others are collaborating to improve rangeland, endangered species habitat, and water quality. The objectives are to protect a nearly pristine ecosystem and maintain economic viability. The ranchers are assisting each other through a proposed revolving loan fund and other innovations.

- Scantic River Watershed, Connecticut - where SCS is working with communities, Environmental Protection Agency and others to improve surface and ground water, flood plain management, wetland protection and restoration, storm water management, and waste management.

TOOLS OF ECOSYSTEM MANAGEMENT

SCS has made extensive use of geographic information systems (GIS) for the past ten years, at all organizational levels of the agency. We currently support over 250 GIS installations at County, State, Regional, and National levels.

Agency applications of GIS include the generation of ecosystem planning maps at the field level and many map-interpretive products using SCS databases such as the National Resources Inventory (NRI) and the National Soil Information System (NASIS). SCS maintains 52+ years of field-collected natural resource data on a wide variety of resources. Though most of these data are tabular, we make extensive use of them by using GIS to aid development of alternatives that support the management of ecosystems for productivity and conservation. GIS is also used to support the strategic planning that is necessary for policy analysis.

Recently we released a report on potential problems on areas that are sensitive to agricultural chemical use. This national-level analysis takes advantage of the NRI and NASIS field collected data at a national level and uses mathematical modeling to generate interpretive maps. Those maps aid problem visualization by displaying ground water quality as it is affected by agricultural chemical use. GIS is also being used extensively within SCS to support the graphic analysis and display of soils data and to support field and watershed-level water quality modeling programs.

FUNDING ECOSYSTEM MANAGEMENT

The current SCS budget structure can accommodate ecosystem management. Both the appropriation and activity structure within each appropriation account provide management with this flexibility. However, SCS' authorizing legislation is primarily intended to prevent erosion and flooding and to improve water quality. Some concern has been expressed by USDA's Office of General Counsel that SCS' authority should be broadened.

Ecosystem-based assistance makes provisions for local involvement and partnerships. These linkages will help provide flexibility in addressing ecosystem concerns by filling technical voids that SCS cannot fill.

There is a need to amend some laws to allow for broader assessments and planning. For example, Public Law 93-566, Watershed Protection and Flood Prevention Act, as amended, limits watershed planning to 250,000 acres. Yet, it is an excellent vehicle for ecosystem management activities. To carry out an ecosystem-based assistance approach, SCS needs authority to plan within a larger area, address more resources and fund more planning than authorized by this current law. The 250,000 acre limitation is appropriate for planning and installing measures on the mainstreams, but is meaningless when planning and implementing upstream and nonstructural measures.

With regards to changing priorities, current program priorities are conservation compliance required by the 1985 and 1990 Farm Bills, wetland protection and delineation, and water quality. SCS is taking an ecosystem approach with the water quality activities. SCS has been moving toward improving ecosystem management through its programs for some time, and there is greater awareness that priorities will be changing -- particularly after the December 31, 1994, deadline for conservation compliance mandated in the 1985 Farm Bill has passed.

There are at least three additional factors that will help to shape SCS' future ecosystem-based assistance capability:

- Budget constraints necessary to limit Federal deficits will continue to put pressure on agencies to streamline and improve efficiencies. This could require SCS to prioritize requests for technical assistance, and could limit assistance to clients in areas not directly tied to provisions of the 1985 and 1990 Farm Bills;

- Adjustments in the size of the Federal workforce as well as the USDA reorganization to create the Natural Resources Conservation Service could alter the mode of assistance and its content; and,

- Legislative mandates could broaden resource mandates and eliminate inconsistencies that currently make integrated, holistic ecosystem-based assistance more awkward than necessary.

Most ecosystem management work is carried out by SCS employees working with partners. Some assessment and GIS studies are conducted under contract. In some cases, SCS has memoranda of understanding with State agencies or conservation districts to provide additional assistance to clients. SCS also enters into contracts to cost-share financial assistance that supports improved ecosystem management by clients. Great Plains Conservation Program long-term agreements and Resource Conservation and Development project measures are examples of this type of contractual arrangement.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

SCS envisions its future role in ecosystem management through ecosystem-based assistance as:

- encouraging, supporting, and providing guidance to private landowners and communities in managing their ecosystems for sustainability;

- working with private and public sector partners in research and adaptive application of ecosystem management techniques;

- propagating and encouraging the beneficial use of indigenous and other plant species through the SCS Plant Materials Program;

- providing educational programs through our Outdoor Classroom Program, AG in the Classroom Program, and other educational programs;

- providing technical counsel and assistance to private landowners and communities as they seek to achieve stability through sustainability;

- facilitating community identification, planning, and implementation of ecosystem management;

- contributing to the goals of public land ecosystem management by providing compatible assistance to persons and entities who manage lands with mixed ownerships;
- supporting a science-based watershed initiative as part of the Clean Water Act reauthorization; and
- assisting other nations through our international programs to understand and implement ecosystem solutions that address local concerns as well as larger issues such as global climate change.

SCS has very few legal restrictions to impede ecosystem-based assistance. Insufficient staff and significant staff reductions could curtail our efforts in two ways.

- We have experienced an almost limitless need for our services, especially in mandated activities such as the 1985 and 1990 Farm Bill conservation provisions, wetlands delineation, and community water quality improvement. Adjusting to a more holistic planning and implementation mandate could further overtax the personnel interacting with clients.
- It would be difficult to strengthen or deploy an adequate mix of disciplines to carry out the more complex assistance work.

To address the technical qualifications needs, SCS is developing a more comprehensive and integrated training program and a technical needs inventory. To meet enhanced skill needs, SCS anticipates recruiting and hiring a wider variety of talents in field such as agroecology, agroforestry, animal ecology, limnology, systems ecology, landscape ecology, and human ecology.

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DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

INTRODUCTION

The principal missions of the National Oceanic and Atmospheric Administration (NOAA) are:

- to promote global environmental stewardship in order to conserve and soundly manage the Nation's marine and coastal resources, and
- to describe, monitor, and predict changes in the Earth's environment in order to ensure and enhance sustainable economic opportunities.

NOAA's vision for the future is a world in which societal and economic decisions will be strongly coupled with an increasingly comprehensive understanding of the environment. A principle component in achieving this goal is the implementation of ecosystem approaches to environmental management and coastal resource development for economic and ecosystem health.

As Federal trustee for living marine resources and their habitats, NOAA foresees both coastal economic health and coastal ecosystem health. To attain this vision, NOAA has developed an "Investment Strategy for Environmental Stewardship". Key program elements of this strategy are:

- To promote healthy coastal ecosystems by ensuring that economic development in coastal ecosystems of the U.S. is managed in ways that maintain biodiversity and long-term productivity for sustained use. Working in partnership at the Federal and State level, NOAA will integrate its operational management activities in an ecosystem-wide approach, increase monitoring in coastal areas, conduct assessments to provide better information for decision-makers, provide education and outreach to increase public understanding, and undertake a more proactive effort in understanding and maintaining marine and coastal biodiversity.
- To build sustainable fisheries by refocusing policies and fishery management planning on increased scientific information, rather than letting controversy and confusion drive the decision-making. NOAA will implement ambitious fishery management plans by addressing problems of uncontrolled access in fisheries, overcapitalization, overfishing, controversial allocation decisions between various fishing groups, and wasteful incidental catch.
- To recover protected species by protecting marine mammals as the public expects and the law requires, while still allowing for economic and recreational opportunities. NOAA will implement recovery plans, take a proactive approach to preventing depleted status designation

for species before it happens, and develop new approaches to reduce conflicts between protected species management and users of marine resources.

As the Federal steward of the Nation's living marine and coastal resources and their habitats, NOAA has a broad range of responsibilities to address coastal environmental issues, including declining water quality and habitat loss, and resource issues (including how best to develop sustainable fisheries and maintain protected species populations). In addition, NOAA has coastal zone and special area (National Marine Sanctuaries and Estuarine Research Reserves) management responsibilities. The common theme underlying each of these responsibilities is the need for managers to be able to diagnose and predict the impacts of human activities and management actions on coastal and marine ecosystems in order to make the decisions that will ensure both environmental and economic sustainability. In order to meet these needs, NOAA conducts and has initiated a number of ecosystem management-oriented programs that seek to restore and maintain the health, integrity and functional values of natural ecosystems that are the cornerstones of productive, sustainable economies.

ECOSYSTEM MANAGEMENT ACTIVITIES

Marine and Coastal Management

The U.S. coastal zone contains some of our Nation's most productive natural resources. NOAA's Office of Ocean and Coastal Resource Management (OCRM) seeks to utilize ecosystem management-oriented programs to protect, restore and promote sound development of the Nation's ocean and coastal resources. OCRM administers a broad spectrum of resource-management programs with authority to address many of today's coastal and marine resource management issues, either directly in the form of the marine resource management and regulatory authorities of the National Marine Sanctuary Program, or in partnership with States and local governments, through their Federally-approved Coastal Zone Management (CZM) Programs, their developing Coastal Nonpoint Source Pollution Control Program components, and the National Estuarine Research Reserve System. OCRM relies on the Coastal Zone Management Act (CZMA) in its efforts to harmonize human demands while optimizing social, economic and environmental values of these ecosystems. Twenty-nine of the 35 U.S. coastal States and U.S. island territories voluntarily participate in the Coastal Zone Management Program partnerships with OCRM to reduce conflicts between land and water uses in the coastal zone and to protect fragile coastal resources. Five additional States are working with NOAA to develop Federally approved programs. Through these CZM Programs, States and territories research, plan, and implement strategies to meet increasing demands for coastal resource use.

Through the National Estuarine Research Reserve System (NERRS) (also established by CZMA), OCRM sets aside estuaries for long-term scientific and education programs that provide information essential to coastal management decision-makers. The NERRS now consists of 22 diverse State-owned and operated sites located throughout the U.S. encompassing over 400,000 acres of coastal habitats. The National Marine Sanctuary Program of OCRM protects nationally significant marine sites around the country, preserving or restoring conservation, recreational, ecological, cultural, educational, historic, aesthetic, and research values. There are currently 13 sanctuaries protecting over 12,000 square nautical miles of marine habitat of the U.S. and American Samoa.

Environmental Assessments

NOAA's Office of Ocean Resources Conservation and Assessment (ORCA) manages a large program of strategic environmental assessments, concentrating on issues of coastal pollution, coastal ecosystem health, and coastal resource uses. These assessments are based on new field and laboratory measurements, analysis of selected existing data sets, synthesis of multi-disciplinary information, diagnostic and forecast modeling, and innovative information display technologies. The program provides major information analysis and delivery systems in a timely, structured, and often customized form to ecosystem and natural resource managers—an essential element of integrated coastal ecosystem management.

ORCA is committed to development and application of scientific protocols and policy guidance to research, pre-event planning, spill prevention, on-scene response, operational forecasting, injury identification, impact mitigation, and environmental assessment of effects of releases of oil and other hazardous substances in the coastal ecosystems. The program works closely with EPA to identify, evaluate, and reduce the risk of hazardous waste site impacts on coastal and marine ecosystems, and to mitigate injury to natural resources from hazardous waste site contaminants through the Superfund process.

ORCA's National Status and Trends Program systematically monitors environmental changes in selected coastal watersheds that are key to meaningful assessment and management of coastal ecosystems. The program detects, quantifies, and forecasts changes in coastal ecosystem health using information from a nationally-networked system of State and Federal coastal ocean and estuarine monitoring programs. Emphasis is placed on rates of introduction of point source and non-point source pollutants, habitat loss, recovery, and restoration rates, indicators of biodiversity, eutrophication, toxic algal blooms, and ecological impacts of watershed land-use practices.

Fisheries Management and Habitat Protection

The decline of fisheries resources is a critical national problem. A major factor in this decline is the continuing loss of significant marine and estuarine habitats. These losses are one of the greatest long-term threats to the Nation's fisheries resources. The capacity of our near shore ocean and estuarine habitats to produce living marine resources is diminishing, while pressures for their conversion to other uses continue. The losses that do occur coupled with the increasing degradation of those that are left, are major factors contributing to endangerment and extinction of species.

To meet this challenge, NOAA's National Marine Fisheries Service (Division of Habitat Research and Restoration, and Office of Habitat Protection) provides high quality scientific advice early in the planning processes of various public and private activities in order to avoid irrevocable damage to habitats and living marine resources. These actions include the use of satellite imagery to assess habitat change and identifying and consulting on any negative effects on marine habitats of hydroelectric, highway, oil and gas exploration, marine contaminating, toxic waste disposal, dumping, and dredging projects. In addition they prepare and submit alternative project plans and/or restoration and mitigation plans. These functions are performed under numerous legal authorities affecting habitat protection, maintenance of clean water, and protection of endangered species.

Ecosystem Prediction

In order to develop an integrated ecosystem understanding, and a capacity for making useful predictions about elements of coastal ecosystems, NOAA's Office of Oceanic and Atmospheric Research is planning an integrated program that will enhance both our observational capacity in the coastal oceans and our ability to incorporate that information into predictive ecosystem models. The basis of this program is research geared to understanding fundamental physical, chemical, and biological processes in coastal ecosystems, and the way they interact with natural and anthropogenic factors to control ecosystem structure and function. Observational systems technology development and deployment will provide the temporal and spatial perspective that allows the research results to be generalized. Ecosystem modeling will integrate the research and monitoring results into a predictive framework. The goal is to provide the management community the tools necessary to:

- assess the status of coastal ecosystems (water quality, fisheries, etc.);
- evaluate the need for management actions;
- identify potential courses of action; and
- provide probabilistic forecasts of the potential impact of those actions.

Environmental observations and research will identify those ecosystem processes essential to designing ecosystem monitoring programs and to developing an integrated, model-based, approach to coastal and marine ecosystem prediction. NOAA will produce a series of management-oriented ecosystem models to serve as the diagnostic and predictive tools that will enable environmental managers to predict the outcomes of their decisions with a rigorous scientific basis. It is critical that the ecosystem modeling development be conducted concurrently with research and monitoring so that the models will reflect, and can be modified according to, the research results. At the same time, model results can be used in an iterative manner to refine both research direction and monitoring strategies.

Modeling efforts will vary in scope from models of individual processes (e.g., productivity models based on nutrient availability and light regime) to models of large lake and coastal ecosystems. (e.g., NOAA's Great Lakes Environmental Research Laboratory [GLERL] scientists developed mathematical models designed to predict the effect of wastewater abatement programs and human development in the drainage basin on Great Lakes phosphorus levels; Louisiana Sea Grant researchers have helped develop a wetlands landscape model that has been used by State and Federal resource management agencies to evaluate the effects of major freshwater diversion projects)

In order for this project to succeed, it is necessary to strengthen the linkage between the scientific and management communities. Socioeconomic models will be included to capture the human dimensions of sustainable development of coastal resources. Inclusion of environmental managers as well as researchers in these evaluations will insure that the predictions that are generated will be relevant to management needs, and that as predictive capabilities are enhanced, the management community will be kept informed.

Cross-Cutting Programs

NOAA's Coastal Ocean Program (COP) is a cross-cutting program designed to expand the Agency's scientific capabilities in selected areas related to coastal ocean management. COP's CoastWatch Change Analysis Program (C-CAP) addresses the need for detailed information on the extent of and changes in important upland and coastal habitats. Scientists and resource managers collaborated with C-CAP to develop a national protocol for mapping watersheds and emergent and submergent habitats, and detecting change through satellite and aircraft remote sensing. The protocol provides a valuable tool for coastal managers because coastal habitats and adjacent wetlands can be consistently documented. C-CAP has already started to assist States in applying the protocol, providing resource managers information needed to protect sensitive seagrass and coastal marsh habitats from destruction. Cooperative linkages have been developed with a network of Federal agencies involved in the management of coastal land and water resources.

COP's Nutrient Enhanced Coastal Ocean Productivity (NECOP) Program was begun to study the effects of nutrient over-enrichment in coastal Gulf of Mexico waters from nutrient-rich freshwater inflows from the Mississippi River basin. The program focuses on assessment of the impacts of nutrient inputs to coastal waters and processes that influence coastal productivity. NECOP researchers were also able to examine and document the oceanographic effects of the freshwater inflow into the Gulf of Mexico as a result of the Great Mississippi River Flood of 1993. NECOP provided near-real-time reporting on the effects seen offshore and later more detailed analyses of nutrients, productivity, and hypoxia.

COOPERATION AND COORDINATION

NOAA ecosystem management-oriented programs develop data bases, information products, assessments and syntheses collaboratively with State and local coastal resource managers, as well as other Federal agencies, private institutions, and foreign entities. In FY 1994, NOAA is working jointly with the EPA to complete a comprehensive implementation strategy for the National Coastal Monitoring Act to serve as an operational framework for a nation-wide, long-term monitoring network for coastal environmental quality and ecosystem health. Contracts and grants to academia and private institutions are used extensively in operational phases. Close liaison is established with the DOI National Biological Survey, the EPA Environmental Monitoring and Assessment Program, and several State monitoring and management agencies. ORCA develops automated information systems and collaborates extensively with the U.S. Coast Guard, Environmental Protection Agency, and the Department of Defense, private institutions (e.g., Marine Spill Response Corporation), and foreign countries (e.g., Saudi Arabia, Kuwait, Canada, Norway), including provision of training and technology transfer.

The Federal-State CZM partnership also asks States to find creative ways of confronting general National problems. Reducing the impact of nonpoint source pollution, for instance, ranks among the most important challenges facing coastal programs. Nonpoint source pollution contributes more than half of the suspended solids, metals, and bacteria which contaminates U.S. coastal waters. The pollution destroys aquatic habitat, smothering aquatic plants and reducing spawning areas. It also affects shellfish growing areas, closing many areas to commercial harvesting with an associated economic loss.

The Chesapeake Bay Division (CBD) of NOAA's NMFS operates inter-jurisdictional partnerships in the Chesapeake Bay area that are aimed at restoring the resources of this large ecosystem, and involves continuous, close and effective coordination with other Federal agencies, State officials, special interest groups and the general public. It is an experiment in watershed management. The CBD participates in numerous committees and councils working to clean-up the Bay and integrates NOAA's capabilities to contribute to this restorative effort.

NOAA/NMFS has also collaborated with the Swan Falls Corporation, U.S. Fish and Wildlife Service, Maine Atlantic Sea Run Salmon Commission, Maine Department of Natural Resources, Maine Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, Maine State Planning Office and many non-government conservation groups in a series of meetings hosted by Central Maine Power to negotiate a fish passage plan for all of the dams on the main stem of the Saco River. In December, 1993 the parties agreed to the objectives, principles, terms and provisions for restoring anadromous fish populations and providing fish passages, and the agreement is now awaiting signature.

NOAA's success in dealing with the eutrophication problem in the Great Lakes is largely due to adoption of an ecosystem management approach by the Federal, State, and municipal governments and their agencies, commissions, and citizens. The Great Lakes Water Quality Agreements of 1972 and 1978 and the Agreement, as amended by protocol in 1987, call for an ecosystem approach. More recently (1991), Federal, State, and local agencies adopted a "Resolution for Interagency Cooperation on Ecosystems Management" which calls for working together on ecosystem research, protection, and management issues where a cooperative interagency approach will facilitate accomplishment of mutual goals. NOAA/GLERL is a signatory to the resolution and has research expertise not available in any other agency in the U.S. Great Lakes region (e.g. expertise in physical limnology and hydrology) which is essential for an ecosystem approach. GLERL's multidisciplinary expertise has provided much-needed support to the U.S. EPA, Army Corps of Engineers, commissions, and State agencies in ecosystem research and management.

NOAA's ecosystem models will be useful not only in its own programs, but also to other Federal and State regulatory agencies in providing a scientific basis for the pro-active and complex decisions that must be made to preserve the quality of coastal ecosystems while permitting sustainable development of resources to occur. Examples of potential applications are: increased precision in fishery recruitment predictions; identifying and protecting critical habitat; and evaluating the cost/benefits of proposed input reduction strategies for anthropogenic nutrients and toxic pollutants. NOAA's previously referenced wetlands landscape model (developed in Louisiana) was the product of collaboration with the Corps of Engineers and Sea Grant.

NOAA is collaborating with other Federal and State agencies to develop an ecosystem management strategy for addressing the serious ecological degradation in South Florida and Florida Bay. As part of this effort, NOAA is supporting the development of a research plan to outline current research needs and a strategy for implementing activities to address these needs. The plan will be fully integrated with planned and underway efforts by the State, the U.S. Army Corps of Engineers, and the U.S. Department of the Interior. It is anticipated that NOAA-sponsored research in this effort will begin in late 1994. NOAA is also a participant in the White House Office on Environmental Policy's "Interagency Ecosystem Management Task Force", and has the lead in developing ecosystem management strategies for Monterey Bay and Prince William Sound. In addition, NOAA has been and continues to be an active member of the Federal Interagency Ecosystem Management Coordinating Group.

TOOLS OF ECOSYSTEM MANAGEMENT

In addition to the ecosystem modeling efforts, such as described above, NOAA develops and applies geographic information systems (GIS) for decision-making, strategic planning, and responding to emergency events -- all essential elements of ecosystem management. NOAA is committed to transfer to the Nation's coastal States, including the Great Lakes, a wide range of existing, but not readily available, coastal resource and environmental quality information, and state-of-the-art, geographic information systems, including desk-top information systems technology and capabilities. For example, local resource managers in Connecticut and Massachusetts are utilizing interactive GIS (resulting from NOAA-funded efforts) to land-use and coastal water quality policy decisions.

FUNDING ECOSYSTEM MANAGEMENT

NOAA is providing support for ecosystem management activities available basis, with high priority being given to specific regions. NOAA is also exploring options for redirection of existing resources, as well as sources of additional support.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

NOAA wants to ensure that economic development in coastal ecosystems of the U.S. is managed in ways that maintain their biodiversity and long-term productivity for sustained use. To move toward this vision, the paradigm for managing coastal ecosystems health will shift from a fragmented to an integrated approach, from a site-specific to an ecosystem-wide context, and from a reactive to proactive mode. NOAA recognizes that coastal and marine ecosystem health problems are complex and that solutions will require a comprehensive, multi-disciplinary approach. Using this approach, NOAA will conduct comparative ecosystem (regional watershed) management activities designed to reduce the cumulative effects of ecosystem stress. Initially, attention will be focused on a limited number of coastal ecosystems to demonstrate the capabilities and benefits of science-based integrated coastal management. By 1999, several representative coastal ecosystems will be included.

NOAA believes that several ecosystem management tasks need to be addressed more vigorously -- tasks that are now both knowledge and resource limited: (a) coastal non-point source management strategies; (b) assessments of economic condition, land use patterns, contaminant sources, habitat management needs, and ecological resources at risk; (c) development of comprehensive regional information systems to support decision-making at the ecosystem level; (d) development of protocols and technologies for monitoring at the ecosystem level; (e) development of the understanding to construct predictive and management support models at the regional level; (f) active translation and dissemination of new information to the public, as well as to management and policy officials, to ensure that economic development can be pursued without sacrificing the health of coastal ecosystems; and (g) implementation and field testing of management strategies.

The Nation's effort to conserve living marine resources and habitat is a difficult one, especially with limited budgets. NOAA's strategy is to effectively and efficiently utilize both existing laws and programs, and budgets. Improved effectiveness will be accomplished by supporting legislation to give Federal and State agencies a stronger role in managing ecosystems and watersheds. The application of available technology to slow and reverse the present pattern of habitat loss will continue. Simultaneously research and development programs will be directed to improve the tools and technologies for restoring, enhancing and creating habitats. Opportunities for working cooperatively with other agencies and third parties that provide leverage for NOAA effectiveness will be sought out. Examples are cooperative efforts with other agencies such as the National Science Foundation, Central Valley Authority in California, PACFISH in the Pacific Northwest, and Florida Bay clean-up groups. In addition, coalitions to protect habitats will be formed with environmental groups, resource users and other special interest groups such as swimmers, naturalists, bird watchers, conservation tourists, private property owners, hotels, marinas, and sports equipment manufacturers. All these activities will be targeted toward increasing ecosystem-oriented conservation awareness and, it is hoped, will provide momentum to making important inroads in the conservation of ecosystems. Over the next decade, NOAA will strive to provide to the Nation an improved scientific basis for sustainable development of coastal, marine, and Great Lakes resources, while also seeking to protect and preserve the unique aesthetic and ecological characteristics of these environments.

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DEPARTMENT OF DEFENSE

ECOSYSTEM MANAGEMENT ACTIVITIES

Policy Level Actions

The Department of Defense (DoD) is actively participating in the White House's Ecosystem Management Initiative, at both Task Force and Work Group levels. We will work to integrate the coordinated definitions, guidelines and principles developed by the Task Force into existing DoD policy directives. An ongoing challenge for DoD is to integrate our stewardship responsibilities with our prime mission of national defense.

Conservation is one of the four pillars of DoD's Environmental Security program. We have committed to completing biological inventories of our installations, and developing and implementing integrated natural resources management plans.

Program Level Actions

Over the past several years, DoD has increased its active involvement in both internal and interagency ecosystem management initiatives. Many of these efforts have been funded by the DoD Legacy Resource Management Program, a FY 1991 initiative to enhance DoD's stewardship of its natural and cultural resources.

One recent Legacy initiative is the funding of a project at the Camp Pendleton Marine Corps Base to develop a comprehensive multiple-species management Plan. In general, we are moving away from a species-by-species management approach to a more holistic approach to ecosystem management.

COOPERATION AND COORDINATION

DoD is an active participant in the Interagency Ecosystem Management Coordination Group. This group is designed to share information, to coordinate projects of interest across agency lines, and to provide a forum to develop new concepts in ecosystem management.

DoD has emphasized the development of partnerships through the Legacy program. These include four initiatives.

- *Biodiversity Initiative*. We are working with the Nature Conservancy and the Keystone Center to review biodiversity within the context of ongoing mission requirements and constraints. The initiative will develop recommendations for the enhancement and protection of biodiversity on DoD lands in a way that is compatible with the mission of DoD. A highlight of this initiative will be a three-day workshop to discuss the findings of this joint venture.

- *Panama Initiative.* In cooperation with the Nature Conservancy, we are conducting a rapid ecological assessment of all DoD installations in Panama. This information will be critical to the management of these resources after we leave the installations.

- *Great Plains Initiative.* In conjunction with the Western Governor's Association, we are supporting a natural and cultural resources overview of the Great Plains between the Rocky Mountains and the Mississippi River.

- *Partners in Flight (PIF) Initiative.* DoD, in coordination with the National Fish and Wildlife Foundation, other Federal agencies, and non-Federal organizations, signed an agreement to participate in cooperative efforts to conserve neotropical migratory birds and their habitats. DoD has five regional PIF working group coordinators and a representative on the National Steering Committee. We have just approved a strategic plan for the conservation and management of neotropical migratory birds and their habitat on DoD lands.

TOOLS OF ECOSYSTEM MANAGEMENT

Gap Analysis Program

Working with fellow partners of the Department of the Interior's National Gap Analysis Program, we are providing funding through the Legacy program to identify distributions of species habitat types, vegetation cover types, land ownership and management. Our FY 1993 efforts focused on work in Louisiana, Oklahoma, and Texas. One goal of our participation is to identify target areas, including DoD lands, where management of biodiversity could be enhanced.

Integrated Training Area Management (ITAM) Program

The Army is using the ITAM program to enhance its management of its training lands. This program helps to mitigate land management problems and includes:

- environmental awareness training for officers and soldiers that emphasizes practicing environmental conservation during training;
- integration of mission requirements with land management;
- state-of-the-art rehabilitation technology; and
- decision support systems such as the Geographic Information System (GIS) which can be used to examine interrelationships, to determine land-use conflicts, to site new facilities, and to conduct environmental assessments.

Spatial Technologies

DoD supports demonstrations of spatial technologies such as remote sensing, global positioning systems, image processing, GIS, and radio telemetry. Currently, DoD's Legacy program is supporting cutting edge applications of some of these technologies to map vegetation communities in the Panama Canal Zone.

FUNDING ECOSYSTEM MANAGEMENT

DoD can implement ecosystem management under the current budget structure. However, like all Federal agencies, DoD is under increasing fiscal constraints that restrict the hiring of natural resources management personnel and the ability to complete all required ecosystem-related work in a timely manner.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

DoD would like to revise existing regulations and to develop guidance specific to ecosystem management. These internal efforts have been delayed by a lack of adequate staffing.

DoD would like to identify new techniques to support ecosystem management. Primacy is given to techniques that will help us to identify our high priority resources more effectively and economically.

DoD intends to play a leadership role in developing an ecosystem management approach throughout the Department. DoD recognizes the importance of partnerships with other agencies and organizations to a successful conservation program and will continue efforts to enhance and expand upon our current initiatives. DoD believes that an ecosystem approach to resource management is the best way for it to continue its mission and its stewardship responsibilities.

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DEPARTMENT OF ENERGY

INTRODUCTION

From the inception of the United States' nuclear energy program, land was set aside for security reasons, as a buffer between the public and laboratory operations, and to study the impacts of energy development activities on the environment. The Department of Energy is now the fourth largest Federal landholder, with 3300 square miles of lands to manage. Portions of this land need to be decontaminated and restored in the coming decade and beyond. This will likely consume fully one-third of the Department's total budget.

The Department of Energy's environmental management policy for these sites has been developed in response to mandates from the U.S. Congress under the National Environmental Policy Act of 1969 (NEPA), specifically through the direction of six environmental goals, to protect the ecosystem processes and achieve environmental quality. NEPA subsection 101(a) states that the Federal government shall "use all practical means and measures...to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans." The Department of Energy, as an outgrowth of its environmental management and research initiatives under this mandate and its ongoing site planning efforts, has achieved modest success in initiating some fundamental elements of ecosystem management throughout its complex in the intervening years.

There are many definitions of "ecosystem management" which are all quite similar; however the individual words are subject to interpretation. It may be better to describe what is involved in the concept: it is a consensual process; based on the best available science; it specifically includes human interactions and management; and uses natural instead of political boundaries. We must recognize that ecosystems change; the planning done must be flexible enough to accommodate changes in the ecosystem, developments in science, and changes in human and economic aspects.

The Department's first initiative on environmental management was the charter of the National Environmental Research Parks (NERP) program in 1975. This has lead to the establishment of seven NERPs across the country. These parks lead the way in many areas of ecological research such as: ecosystem function and human impacts; concepts of maintenance of genetic diversity, ecosystem health, and the importance of ecosystem function; and the fundamentals of realistic ecosystem management. As a result we have developed a world-recognized science and technology base in ecosystem issues, health and impacts.

More recently, the establishment of the Department's Office of Environmental Management in 1989 and recent passage of new environmental legislation (Federal Facility Compliance Act, Community Environmental

Response Facilitation Act), the reauthorization of Comprehensive Environmental Response, Compensation and Liability Act and the Clean Water Act, and the issuance of new Executive Orders (such as on Environmental Justice and on Wetlands), have caused the Department's environmental perspective to include a broader ecosystem context with the active involvement of Native American tribes, State and local governments and interested parties. In the past, Department-wide coordination of a proactive ecosystem management approach at its sites and with interactions with other agencies has been limited; this is changing.

The Department's current focus on the dynamic changes occurring with respect to redefining its missions and its effort to clean-up almost 50 years of pollution at its sites have led it to the issue of addressing future uses at specific sites and including ecosystem-based management. In 1993, the Secretary of Energy committed to a renewed emphasis to the pursuit of total quality environmental management by stating its Department Mission to be one of "providing the scientific foundation, technology, policy and institutional leadership necessary to achieve...improved environmental quality."

Several organizations within the Department are participating in a process of developing a shared vision of the desired condition of its sites and their host regions consistent with the overarching goal of maintaining the natural sustainability and biological diversity of the ecosystem while supporting sustainable economic development and communities. The Office of Environmental Management, the Office of Facility Management, the Office of Environment, Safety and Health, the Office of Energy Research, and the Office of Environmental Analysis in the Policy Office have all contributed to this effort.

The Department currently has in place two internal directive Orders which provide the basic tools for implementing a proactive ecosystem management approach to ensuring a sustainable environment and a sustainable economy and a redirected mission to promote the concept. The Orders state that the Department is committed to environmental protection goals, restoring environmental quality, and addressing regional and local concerns in planning analysis.

The Ecosystems Management issue is an opportunity for the Department to demonstrate a serious commitment to Total Quality Environmental Management. The opportunity to implement science and consensus-based management is now. We can take the experience we have developed and make the transition into ecosystem management.

ECOSYSTEM MANAGEMENT ACTIVITIES

The Energy Reorganization Act of 1974 mandates that the Department of Energy (at that time, called the Energy Research and Development Administration (ERDA)) engage in environmental research related to the development of energy sources so as to advance the goals of restoring, protecting and enhancing environmental quality.

The Mission Statement for the Department of Energy states, in part, that the Department will provide "the scientific foundation, technology, policy and institutional leadership necessary to achieve...improved environmental quality."

Several organizations within the Department have become involved in a participatory process of developing a shared vision of the desired condition of its sites and their host regions consistent with the overarching goal of maintaining the natural sustainability and biological diversity of the ecosystem while supporting sustainable economic development and communities.

The Office of Environmental Management was established in 1989 as a single line organization to implement cleanup, compliance, and waste management responsibilities with the creation of a new culture and an emphasis on environmental and safety concerns. A major initiative has been to foster an open process of identifying the potential future use options at its sites and the integration of stakeholder-preferred future uses into site and Department planning and decision-making.

The newly established Office of Facility Management has taken the current level of Department planning from the management of site real-property and facilities to a more holistic approach which integrates stakeholder and community concerns and visions creating a regional planning process.

The Office of Environment, Safety and Health has done extensive work in defining and providing structure for the implementation of the National Environmental Policy Act and that of the Comprehensive Environmental Response Compensation and Liability Act within the Department. A major initiative is underway utilizing an ecosystem management approach to minimizing natural resource damages.

Basic scientific research continues to be accomplished under the direction of the Office of Energy Research through its National Environmental Research Parks. This effort has built a foundation of knowledge regarding ecological interactions and environmental compatibility of technology development and human use, which the Department and the Nation can use as they further embrace this new ecosystem management approach and redirect planning and decision-making efforts to successfully achieve a strong link between a healthy economy and a healthy environment.

The Office of Environmental Analysis, within the Office of Policy, Planning, and Evaluation, is reviewing and developing the Department's integrated approach to a broader consideration of the ecosystem as a dynamic community of biological organisms, including humans, and the physical environment with which they interact. The Office of Policy, Planning, and Evaluation is the lead office for the Department's effort with the Interagency Ecosystem Management Task Force.

The Charter for the National Environmental Research Parks has these objectives: "to develop methods to quantitatively and continuously assess and monitor the environmental impact of man's activities; to develop methods to estimate or predict the environmental response to proposed and ongoing activities; and to demonstrate the impact of various activities on the environment and evaluate methods to minimize adverse impacts." The 1985 document *Department of Energy National Environmental Research Parks* characterizes the extent and activities at the research sites.

The Department currently has in place two Orders which provide the basic tools for implementing a proactive ecosystem management approach to ensuring a sustainable environment and a sustainable economy and a redirected mission to promote the concept.

- Regarding the environment, as stated in DOE Order 5400.1(1.5.a) "...DOE is firmly committed to ensuring incorporation of national environmental protection goals...to advance the goals of restoring and enhancing environmental quality..."

- Regarding a broad planning perspective, under DOE Order 4320.1B, the Department is able to address the regional and local conditions surrounding its sites, identify present land uses and future opportunities at the site, in performing a planning analysis.

Under the Secretary's leadership, the organizations within the Department are working to coordinate and integrate the previously disparate elements of ecosystem management into a unified Department agenda. Only by redirection of this mission can the Department and its sites achieve Total Quality Environmental Management and ensure a sustainable environment and sustainable economy.

Department of Energy Ecosystem Management Team

Bill Breed	Office of Policy, Planning and Evaluation
Bill Osburn	Office of Energy Research
Randy Harris	Office of Environmental Management
John Bascietto	Office of Environment, Safety and Health
Don Trost	Office of Field Management
Clive Jorgenson	Office of Energy Research
Jeff Crater	Office of Environmental Management
Helen McCammon	Office of Energy Research
Bill Metz	Argonne National Lab
Don Elle	Nevada Test Site NERP
Rod Walton	FermiLab NERP
Lee Rogers	Hanford NERP
Ron Chesser	Savannah River NERP
Tim Reynolds	Idaho National Engineering Lab NERP
Mike Huston	Oak Ridge NERP

COOPERATION AND COORDINATION

Many other agencies and interests are becoming involved in future use and management issues at Department of Energy sites. The Department continues to foster cooperative research efforts, economic development initiatives, and participation protocols with Federal agencies, tribes, and State and local governments, plus universities, businesses and industries, and interested citizens. Citizen advisory groups continue to be established at Department sites.

Federal agencies involved in cooperative research work and ecosystem management at various Department sites include: the Bureau of Land Management, the Fish & Wildlife Service, the National Science Foundation, the Forest Service, the Bureau of Reclamation, the Environmental Protection Agency, the Tennessee Valley Authority, and the Department of Defense.

Where appropriate, activities at NERP sites have been coordinated with the International Biological Program (IBP), the Man and Biosphere Program (MAB), and with the National Science Foundation Long-Term Ecological Research (LTER) program. They have been used as research areas by many of the local universities, including Washington State, Colorado State, the University of California, the University of Georgia, the University of Tennessee, the University of Idaho, the University of New Mexico, the University of Nevada, and many other universities.

The Office of Policy, Planning and Evaluation represents the Department in the Interagency Ecosystem Management effort. We view this as an opportunity for cooperative efforts for realization of the Nation's environmental and economic goals.

TOOLS OF ECOSYSTEM MANAGEMENT

All of the National Laboratories have extensive experience in the use of advanced computer technologies, involving tools such as geographic information systems (GIS) and CAD/CAM for information and data management and analysis. Examples of analyses include: dynamic site characterization and management planning, including remediation planning; analysis of climate change-induced sea level rise, incorporating bio-geophysical processes; and analyses of energy and environmental issues, such as tropospheric ozone mitigation policies. In addition, there is an overall ParkNet computer network between sites, with a common database, system utilities, standard reporting, and statistical analysis software. The Department also maintains a data base of all facilities with geographical, functional, and ownership information. This data is housed in the Department's Facility Information Management System maintained by the Office of Field Management. Within the Headquarters, both the Policy Office and the Energy Information Agency use a GIS for analysis of policy and environmental issues.

The growing diversity of uses and applications provides a strong argument for the value of a standard Geographic Information System approach for evaluation of ecological management and policy issues. The development of a standard GIS to be used at each site would facilitate a coordinated examination and analysis of different interests and options, enhance understanding and communication, and facilitate conflict mediation.

FUNDING ECOSYSTEM MANAGEMENT

Funding for ecosystem management resides in many different Departmental organizations, and will continue to do so within the Department in the future. Recognition and priority of this overarching approach is required, perhaps in an independent budget crosscut to ensure integration and coordination among programs and continued emphasis. The Department of Energy anticipates that increased attention to the value of integrated management of resources, environmental problems and economic development, in a holistic or ecosystem manner in the future will actually be more cost-effective. Implementation of full-blown ecosystem management will have a definite cost, but with a resultant increase in quality of the environmental management and outcomes.

The Department's intention is to move forward in utilization of the experiential and technical resource for the application of ecosystem concepts and concerns into Department of Energy land use planning and vision for the future. In the future, with dwindling agency budgets, we may be constrained in staffing and activities associated with the sites.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

The Department of Energy will continue to take a leadership role on the leading edge of ecosystem management to fulfill its missions. This leadership is critical for our environmental and stewardship responsibility to cleanup the cold war lab sites, but also to look to the future to provide a sustainable ecosystem and to support sustainable economic development and communities for future generations.

The ecosystems management initiative within this Administration is an opportunity for the Department to coordinate its activities among organizations and sites in a continuing serious commitment to Total Quality Environmental Management. We can take our present and past experiences and make the transition into a Department-wide ecosystem management approach. As institutional changes occur within the Department, and the DOE order for site development planning is being revised, this is an excellent chance to implement ecosystem concerns into the Department of Energy's long-term management plans.

At the present time, implementing a comprehensive, integrated ecosystem management approach within the Department is not impeded by legal restrictions, DOE orders, or regulations. The basic elements and experience base presently reside within the Department and the sites. In order to fully achieve an effective role for ecosystem management, the Department is reviewing its organizational structure to determine the policy options, efficiencies, and management opportunities.

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DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS

INTRODUCTION

The development, use, and protection of natural resources is essential to the identity, culture, and livelihood of Native Americans. Indian reservations are working examples of ecosystem management. Tribes have always pushed for the integrated management of Indian lands and have accomplished much in the way of ecosystem management long before the concept was recognized by the scientific community. The Bureau of Indian Affairs (BIA) views Integrated Resource Management Planning as the delivery mechanism for the expansion of ecosystem management to every reservation, village, rancheria, and individual Indian allotment throughout the United States. Native American ecosystem management is a proven tradition.

ECOSYSTEM MANAGEMENT ACTIVITIES

The BIA mission is to enhance the quality of life, promote economic opportunity, and carry out the Federal government's responsibility to protect and improve the trust assets of American Indians, Indian tribes, and Alaska Natives. The BIA is the lead trustee for over 500 recognized Indian tribes and Alaska Villages. Essential to the BIA's mission is the maintenance of government-to-government relationships with sovereign tribes and nations in fulfillment of Indian self-determination. Indian reservations should be viewed as ecosystem management in action. There are no other places in the United States where the development, use, and protection of natural resources is so fundamental to the identity, culture, and livelihood of the people who reside within them.

The BIA does not have a working definition of ecosystem management, nor is that appropriate. Indian tribes are leaders in ecosystem management. The BIA looks to the Indian landowner to define the scope and depth of ecosystem management. As a result, one can expect the complexion of ecosystem management to vary throughout the country. The principles of ecosystem management existed long before the term was accepted and recognized by the scientific community. These principles can be expressed in simple terms. Food, clothing, shelter[3]; water, spirit, culture[4]; seven generations before us, seven generations after us[5]; all things are connected[6].

Indian lands are not public lands. As such, the BIA does not make resource management decisions. The Indian people do. The BIA's role is to provide technical assistance and funding for sound resource management decisions. To date, our efforts have fallen short of tribal needs. In the early 1980's, the BIA embraced what is now being called ecosystem management by adopting what was then being called Integrated Resource Management Planning. However, our early efforts stalled. Organizationally, the BIA was not prepared for this concept and remains segregated by program functions (e.g., timber, fish, wildlife, range, water). Funding for integrated resource planning never came about. Early efforts resulted in a layering of program-specific management plans, rather than the integration of resource management.

Today, the BIA is reviving integrated resource management as a broad policy objective. Tribal culture demands it, some tribes have it, but most are waiting. Integrated Resource Management Planning is called for in the National Indian Forest Resources Management Act (P.L. 101-630), the American Indian Agricultural Resources Management Act (P.L. 103-177), and in bills for the Indian Fish and Wildlife Resource Management Act currently before the House and Senate (H.R. 2874 and S. 1526, respectively). The Indian people pushed for these laws and are demanding the type of management that treats their resources as one.

At the program level the BIA established a nation-wide Geographic Data Services Center that provides leadership in geographic information systems (GIS) applications. Ready access to a common spatial database is building trust amongst resource disciplines, whether they be tribal or BIA in administration. The BIA leads all Federal land management agencies in a permanent continuous forest inventory of major forested reservations that allows for the historical analysis of the health and condition of Indian forests. The BIA's Office of Trust Responsibilities supports several ecosystem management initiatives in forestry, fish, wildlife, and recreation. Specific projects focus on issues of common concern to State, Federal, and tribal governments to ensure the continued exercise of treaty hunting, fishing, and gathering rights.

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[3] James S. Hendrickson, Chairman, Grand Portage Reservation Business Committee. 1984. Letter to tribal members soliciting input on a new [circa 1984] Multiple-Use Natural Resources Management Plan.

[4] Port Gamble S'klallam Tribe, Kingston, Washington. 1994. Presentation by Steve Moddemeyer, Forest Management and Inventory Planning Meeting, Portland Area Office, Bureau of Indian Affairs, March 1-3, Spokane, Washington.

[5] Ada E. Deer. Assistant Secretary for Indian Affairs. 1994. Presentation to Northwest Watershed Restoration/Partnership Conference, February 16-17, Tacoma, Washington.

[6] Ibid. Quoting Chief Seattle.

Visit a reservation anywhere and you will find a working example of ecosystem management. You will also find accomplishment.

COOPERATION AND COORDINATION

The BIA cooperates with Indian tribes, Alaskan Villages, and individual Indian landowners throughout the United States. The BIA's budget system and reorganization effort, which is consistent with the recommendations in the Federal government's National Performance Review, allows tribes to set priorities through localized decision-making. Many tribes have developed their own staffs for resource programs through Indian self-determination (P.L. 93-638) contracts. Furthermore, the Federal government's Self-Governance demonstration has proved successful in enabling participating tribes to take full control over program and services with a minimum amount of Federal oversight.

As a result, the BIA maintains unique government-to-government relationships with each Indian tribe and Alaska Village. These relationships can be loosely grouped into three broad categories and may differ by program within the purview of a single tribe: 1) on-site consultant (BIA Field Agencies), 2) administrator of P.L. 93-638 contracts (contract support for tribal programs), and 3) trust responsibility oversight (annual Trust Evaluations of Self-Governance compacts). None of these relationships preclude the implementation of ecosystem management activities on Indian lands. In all cases, the tribes are the resource managers and need continued Federal support through funding and technical assistance.

The BIA's interaction with other Federal agencies is usually on behalf of Indian tribes affected by other agency decisions. For example, the BIA regularly cooperates with the U.S. Fish and Wildlife Service on compliance matters pertaining to the Endangered Species Act. Interagency cooperation occurs regularly at the national level. Examples include the resource protection efforts of the National Interagency Fire Center in Boise, Idaho, and the coordination of interagency Forest Pest Management and Forest Health Initiative projects on Indian lands.

The level of interagency cooperation has increased with the adoption of ecosystem management policies by most Federal agencies. The best example is the level of cooperation initiated by the Bureau's Portland Area Office in conjunction with the pending implementation of President Clinton's Forest Plan on Federal lands within the range of the northern spotted owl. The Portland Area Office has assigned technical staff, part-time, to 17 of the 19 Interagency Implementation Team Work Groups. In addition, the Area Director has a full-time representative working for the interagency Regional Ecosystem Office, and has on temporary detail another individual who serves as Acting Director of this office. With respect to President Clinton's Forest Economic Readjustment Initiative, the Portland Area Office has staff serving on the Regional, Washington, and Oregon Community Economic Revitalization Teams (CERTS). Furthermore, several tribal and intertribal representatives are serving on the northern California, Oregon, and Washington CERTS. The BIA envisions greater tribal participation in watershed analyses and provincial planning once plan implementation is underway. Field Superintendents in the BIA have been designated as the line officials to serve on interagency provincial planning teams.

Cooperation with State, local, and private landowners is usually initiated by individual tribes, or by intertribal consortia such as the Columbia River Inter-Tribal Fish Commission, the Northwest Indian Fisheries Commission, the Intertribal Timber Council, the Intertribal Agriculture Council, the Great Lakes Indian Fish and Wildlife Commission, and the Chippewa-Ottawa Treaty Fishery Management Authority. Examples include the cooperation of several tribes in the State of Washington's Timber, Fish, and Wildlife Initiative for improving forest practices, enhancing streams, and restoring wildlife; and several initiatives in the Lake States which coordinate tribal fishing, hunting, and gathering rights with non-Indian activities and land use.

The Interagency Ecosystem Management Coordination Team plays a key role in coordinating the BIA's ecosystem management activities at the national level. The BIA supports the team's mission to develop a long-range agenda for ecosystem management. It is only proper that the BIA showcase the many examples of ecosystem management on Indian reservations.

TOOLS OF ECOSYSTEM MANAGEMENT

In 1984, the BIA established the precursor of today's Geographic Data Service Center. Located in Lakewood, Colorado, the Geographic Data Service Center anchors the BIA's expertise in automated geographic analysis tools. The center's mission is to transfer automated geographic analysis tools to Indian tribes in support of tribal management of Indian resources. The center is divided into four major groups: administration, computer systems, remote sensing, and geographic information systems (GIS). In 1993, a total of 328 field users, including 144 tribal users (representing 57 tribes), performed over 33,000 hours of geographic data analysis through access to the Geographic Data Service Center.

The administrative group is responsible for the daily management of the center, and for coordinating BIA conferences and training throughout the United States. Recent accomplishments include a Winter GIS Users Forum, and technical workshops on the SUN workstation (OS/UNIX operating system) and ARC/AML programming. The computer systems group maintains all computer hardware and develops software for system operability. The group manages data workspaces, operates the local area network, and is the liaison with commercial software developers.

The remote sensing group is responsible for terrain data processing, satellite image mapping, watershed analysis, and land cover mapping (e.g., woodland, forest, range, agriculture). Recent projects include the Ft. Berthold

Indian Reservation (North Dakota) watershed analysis, the Pine Ridge Indian Reservation (South Dakota) woodland mapping, the Winnebago and Omaha (Nebraska) Indian Reservations agricultural crop land mapping, and fire/fuels mapping for the Zunni, Ramah-Navajo, and Ute Mountain Reservations in the southwestern United States.

The geographic information systems group coordinates data entry, database development, user support, and training specific to GIS applications. Readily accessible through modem, the Geographic Data Service Center's ARC/INFO GIS system is being increasingly used by tribal and Bureau personnel in the Lake States, Pacific Northwest, and Southwest regions of the United States. To date, over 170 Indian reservations have basic coverages for streams, roads, public land survey, physiographic features, and vegetation. A significant accomplishment was the successful transfer and quality control of over 35,000 coverages from the old Prime System to the SUN workstation. The GIS group supports a full time help desk to assist remote users.

Just as important is the expansion and use of automated geographic analysis tools by individual tribes. Many larger Indian reservations (e.g., Yakama, Flathead, and Ft. Apache) have their own GIS systems. Others are working with private contractors to utilize satellite imagery data to develop forest cover type maps (e.g., Quinault Indian Reservation). Perhaps the biggest success is that these tools are breaking down barriers between resource disciplines as everyone's data becomes accessible and useable. The Bureau of Indian Affairs' Ecosystem Management display will highlight the use of GIS in the development of an Integrated Resource Management Plan by the Spokane Tribe of Indians[7].

The BIA is not aware of any specific cooperative projects involving tribes or Indian lands in the U.S. Fish and Wildlife Service's Gap Analysis Program. However, local conservation groups are aware of the significant contributions to biodiversity that Indian lands provide, and that any assessment of the distribution and size of protected areas for plant communities and individual species should not overlook these contributions. Perhaps the biggest barrier in ensuring cooperation is in respecting the proprietary nature of reservation data and the sovereignty in tribal decision-making. The Haskell Indian Nations University[8] (in cooperation with the Department of Interior's National Training Center) would be a good starting place for coordinating the use of Native American high school and community college student participation in gap analyses.

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[7] For more information, contact the Honorable Bruce Wynn, Chairman, Spokane Tribe of Indians, Post Office Box 100, Wellpinit, Washington 99040 (Attention: Mary Verner, Director, Natural Resources Planning).

[8] Natural Resources Program, Haskell Indian Nations University (formerly, Haskell Indian Junior College), 155 Indian Avenue, Lawrence, Kansas, 66046.

FUNDING ECOSYSTEM MANAGEMENT

The Bureau of Indian Affairs (BIA) budget is not structured to accommodate ecosystem management. Rather, the BIA's budget is prioritized to deliver quality social and educational services to Indian tribes. Natural resource management is driven by the specific needs of Indian tribes, and in most cases the primary need is for sustainable economic development providing income for tribal programs and jobs for tribal members. Natural resource budget priorities are set to deliver particular commodity outputs, and as such, are not well suited for managing the land as a whole.

Most environmental protection activities on Indian lands are made possible through viable commodity-oriented programs like timber, mining, range, commercial fisheries, and agriculture. For example, a viable timber program provides the infrastructure and income to stabilize roads, conduct watershed analyses, manage wildlife habitat, survey cultural resources, as well as provide basic resource protection from fire, insects, and disease. Therefore, programs or staff that deal primarily with environmental protection are put at a budgetary disadvantage since they do not generate the income needed to pay for their services (e.g., archeology, cultural resources, environmental quality). Similarly, commodity programs are increasingly being asked to fund environmental protection services at the expense of meeting otherwise attainable and environmentally sound levels of production.

The BIA is hesitant to restructure budget priorities to specifically accommodate ecosystem management. Rather, the BIA budget system allows tribes to set budget priorities to meet specific tribal needs. Tribes have the flexibility to move allocations around to fund programs that are needed most. In this type of budgetary environment, the key ingredient to successful ecosystem management on Indian lands is the completion of Integrated Resource Management Plans (IRMPs). Tribal decisions regarding how resources will be valued, protected, and used; and to what extent impacts to the environment will be acceptable, must be made in IRMPs. Ecosystem management, as defined by each tribe, can be accomplished if tribal budget priorities are required to reflect resource allocation and protection decisions made in IRMPs. Quality resource management can be assured if funding allocations are based on, and therefore require, IRMPs.

Increasingly, tribal staff and operations are conducting resource management through P.L. 93-638 Indian Self-Determination contracts or Self-Governance compacts. The best available data in assessing contracting trends is from the BIA's Division of Forestry[9]. Since 1984, tribal staff within the forestry program has increased over 226 percent through the use of P.L. 93-638 contracts and compacts. In fiscal year 1993, over 40 percent of the forestry program budget (net of contract support) went to self-determination contracts and compacts. Nearly 100 percent of allocated forest management deductions from stumpage receipts went back to tribal programs. In addition, tribes contributed over $2.7 million of their own funds to their forestry program (approximately 5 percent of the total budget). The BIA expects these trends to occur in all resource programs if new funds for ecosystem management become available. Most likely, implementation would occur through the expansion of tribal staffs through the use of P.L. 93-638 contracts and compacts.

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[9] Bureau of Indian Affairs, Division of Forestry. 1994. Forestry Program Funding and Position Analysis. FY [fiscal year] 1993. United States Department of the Interior, Washington, D.C. [232 pages, non-conventional pagination].

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

Ideally, the BIA would like to be in a position to unequivocally support Integrated Resource Management Planning on every reservation, village, rancheria, and individual allotment throughout the United States. This requires adequate funding, staffing, and organization. As an example, a recent independent scientific assessment of the Indian forestry program recommended a 182 percent budget increase to bring funding levels for the coordinated planning and management of Indian forest lands on par with that of the National Forests[10]. In addition, the study identified the need for an additional $200 million for road system improvement and $150 million for forest development treatments (reforestation, fertilization, thinning). In doing so, the study identified the value of coordinated resource plans (i.e., integrated resource management) in directing investments to best meet tribal needs.

If done properly, an Integrated Resource Management Plan (IRMP) will meet programmatic compliance needs for the National Environmental Policy Act, as well as programmatic compliance with specific tribal laws and Federal environmental mandates such as the Endangered Species Act and the National Historic Preservation Act. Furthermore, an IRMP will streamline the compliance process for specific projects implementing tribal resource programs pursuant to the goals and objectives in the plan. The advantage with an IRMP is that environmental compliance is assured through a single effort and assesses the combined environmental effects of all resource activities. Compliance is no longer a bureaucratic exercise, but rather serves the planning and monitoring needs for an entire reservation.

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[10] Indian Forest Management Assessment Team. 1993. An assessment of Indian Forests and Forest Management in the United States. Intertribal Timber Council, Portland, Oregon. [163 pages, non-conventional pagination].

To date, BIA organization and program funding has not been conducive to developing IRMPs. The BIA estimates an additional $42 million annual funding need to meet increasing demands for environmental compliance (over 20 Federal environmental mandates, and an additional 5-10 tribal mandates, have been identified)[11]. Current limitations include a shortage of staff expertise to conduct the necessary field work and documentation for timely compliance to meet tribal program needs with the least amount of interruption. In addition, the BIA estimates an annual $10 million funding need for Integrated Resource Management Planning. This money is needed to develop the staff and program infrastructure for developing IRMPs. In total, an additional $50 million annual funding level would overcome financial limitations to ecosystem management on Indian lands.

The BIA recognizes the fiscal austerity facing all Federal agencies. Current strategies do not hinge entirely on acquiring this new funding. Rather, the BIA will be looking to all Federal agencies to support the Federal government's trust responsibility to Indian tribes. As an example, the BIA is investigating whether Environmental Protection Agency General Assistance Grants can be used to fund Integrated Resource Management Planning programs. Furthermore, regulatory agencies must secure funding to alleviate the financial burden many environmental mandates place on Indian tribes.

SUMMARY

The Bureau of Indian Affairs will continue to identify the ecosystem management needs of American Indians, Indian tribes, and Alaska Natives. Since Native Americans are leaders in ecosystem management, we do not expect dramatic shifts in tribal resource policies. Instead, Indian tribes and Alaskan Villages have been waiting for Integrated Resource Management Planning to be accepted as the means to develop and implement their ecosystem management concepts. The BIA recognizes that successful Integrated Resource Management Planning will not occur without the cooperation and contributions of all Federal land and resource agencies. In the meantime, the BIA will continue its role of technical assistance in resource inventory, geographic analysis, and planning. Native American ecosystem management is a proven tradition.

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[11] Bureau of Indian Affairs. 1993. Office of Trust Responsibilities Trust Resources - Environmental Mandates FY [fiscal year] 1994-1998 Funding Needs Assessment. All Areas, Needs Estimate Report. Division of Forestry, Branch of Forest Resources Planning. DRAFT [database].

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

INTRODUCTION

The Bureau of Land Management (BLM) is responsible for the administration of 270 million acres of public lands representing a variety of ecosystems, from the sun-drenched deserts of the arid Southwest to the lush old-growth forests of the Pacific Northwest, to the pristine Arctic tundra of Alaska. The BLM has adopted the principles of ecosystem management to guide its management of the public's lands and resources.

The cumulative effects of past activities on public and private lands have often led to degraded aquatic and riparian systems; less productive rangeland conditions; fragmented plant, animal and fish habitats; and forest health problems. Human population growth, non native plants, historical overuse, and other factors, have also contributed to degradation of the public lands causing significant declines in the range and numbers of many native flora and fauna.

Public lands are also the last refuges for many vanishing species. Over 191 Federally listed threatened and endangered plant and animal species, and over 1,100 candidate species, occur on BLM lands. BLM lands provide habitat for at least 109 salmon and steelhead stocks that are threatened with extinction.

Communities whose economies depend on public lands are often the most seriously affected by ecological degradation. The declining timber and commercial and recreational fishing industries of the Pacific Northwest have seen the economic repercussions and social displacement accompanying ecosystem degradation. Conservation efforts on public lands make a critical difference to the viability of vulnerable plant and animal species, and the stability of local economies. Poor forest and rangeland health, degraded riparian areas, and inferior aquatic habitats threaten species' viability, resource productivity, and, ultimately, the overall sustainability of ecological systems on which humans depend.

Since ecosystems cross jurisdictional boundaries, the BLM is encouraging partnerships, sharing management responsibilities, and establishing common management goals with other Federal, State, and private land managers, local communities, and other interested domestic and international parties.

ECOSYSTEM MANAGEMENT ACTIVITIES

For the BLM, ecosystem management is the integration of ecological, economic, and social principles to manage biological and physical systems in a manner safeguarding the long-term ecological sustainability, natural diversity, and productivity of the landscape. The primary goal of ecosystem management is to develop and implement management that conserves, restores, and maintains the ecological integrity, productivity, and biological diversity of public lands. Sustainable ecosystems provide many benefits for wildlife and humans such as habitat for fish and wildlife, clean drinking water for communities, wood, fiber, forage, recreational, and economic opportunities.

BLM management actions will be governed by the following principles: sustain the productivity and diversity of ecological systems; gather and use the best available scientific information as the cornerstone for resource allocations and other land management decisions; involve the public in the planning process and coordinate with other Federal, State, and private land owners; determine desired future ecosystem conditions based on historic, ecological, economic, and social considerations; minimize and repair impacts to the land; adopt an interdisciplinary approach to land management; plan and manage on long-term goals; reconnect isolated parts of the landscape; and practice adaptive management.

While there are legal provisions Congress could enact to facilitate ecosystem management, the principles described above are consistent with the mission of the BLM. The BLM's mission of "multiple use" is described in the Federal Land Policy and Management Act (FLPMA) (43 USC 1702(e)).

The BLM is implementing numerous management efforts consistent with the principles of ecosystem management. Bring Back The Natives for example calls on a number of cooperators to help restore the health of entire riverine systems through watershed rehabilitation and responsible resource stewardship. During 1993, the BLM implemented 29 projects in 13 Western States benefiting a wide variety of aquatic species and wildlife, and contributing toward the recovery of targeted and threatened species.

The BLM has also been actively involved in the Partners In Flight - Aves de las Americas. This international initiative seeks to stabilize declining populations and focuses on improving habitat and managing ecosystems for many neotropical bird species throughout their migratory routes, sometimes spanning 10,000 miles.

In California, the BLM signed a Memorandum of Understanding (MOU) with other Federal, State, and county partners to develop a coordinated, State-wide biodiversity planning strategy. This effort is coordinating the actions of the principal land management agencies under the long-term goal of conserving the rich natural heritage of each major bioregion in California while maintaining economic growth and development.

COOPERATION AND COORDINATION

For the last few years, the BLM has been actively cooperating with other Federal and State agencies in managing the Nation's public lands. For example, Bring Back The Natives is supported and sponsored by the BLM, USDA Forest Service, and the National Fish and Wildlife Foundation. Additionally, multiple private organizations, such as Trout Unlimited and the Rocky Mountain Elk Foundation, are involved in site specific project implementation. Now in its third year, Bring Back The Natives involves 67 Federal, State, local, and private partners and implemented over 30 projects benefiting a wide variety of aquatic species and wildlife. During 1994, over 50 Bring Back The Natives projects will focus on restoring native species and watersheds in 14 Western States.

The Partners In Flight initiative is a multifaceted coordinated management effort for neotropical migratory birds involving Canada, the United States, Mexico, the Caribbean, Central America, and South America. At the conclusion of 1993, 14 Federal agencies, 55 State and provincial fish and wildlife agencies, 34 nongovernmental organizations, and 14 private companies in the Western Hemisphere were actively involved in this unprecedented conservation effort.

The BLM and USDA Forest Service are merging and expanding their respective Pacific anadromous fish habitat programs into an ecosystem approach for aquatic habitats and riparian area management. The effort, called PACFISH, will conserve and restore Pacific salmon and steelhead habitats and associated watersheds on Federal lands in the West. PACFISH stresses the integration of sound scientific information with on-the-ground management direction. PACFISH principles form the aquatic component of the Forest Ecosystem Management Assessment Team (FEMAT) plan.

The BLM is a member of the Steering Committee of the Interagency Ecosystem Management Coordination Group (IEMCG), which consists of 20 Federal agencies, and actively participates in many of the Group's Subcommittees. The BLM is assisting in drafting the Interagency Principles of Ecosystem Management. The BLM is a member of the Group's Outreach Committee and spearheaded the design, creation, and production of the Interagency exhibit and fact sheet for the poster session at the symposium sponsored by the Congressional Research Service. The BLM is a member of the Group's Training Committee. The BLM also assisted in drafting the IEMCG MOU which will state the primary role of the Group as ". . . fostering collaboration among diverse agencies to develop a long-range agenda for ecosystem management."

TOOLS OF ECOSYSTEM MANAGEMENT

The BLM's multiple use mission requires complex analyses of the potential impacts of alternative resource management decisions which range in scope from habitat improvements of one acre to environmental analyses for proposed pipeline rights-of-way extending up to 1,000 miles, to complex ecosystem analysis in the Pacific Northwest. The applications for geographic information systems (GIS) in the BLM are extensive both in terms of the land area being managed and the conflicts regarding the use of the land. The primary application of GIS in the past has been the analysis of data in support of Environmental Impact Statements and Land Use Planning. By implementing

GIS capabilities throughout all the BLM offices, a vast data base will be accessible for subsequent decisions and for public inquiries.

BLM management has committed to GIS development as a top priority of the agency, with the many associated activities guided through a Master Plan which will be regularly updated. After ensuring that the GIS concept guided the development of automated systems within the agency, the BLM defined as a priority the implementation of a data administration program to meet GIS goals and objectives.

One of the first components of GIS to be implemented will be the Automated Land and Mineral Record System (ALMRS). When fully implemented, the GIS data base will include the land and mineral records data to provide information about land status and authorizations. Automated Resource Data (ARD) will include the resource values, management concerns, and characteristics of the land, as well as base data about topography, transportation, and basic cultural features. The automated Geographic Coordinate Data Base (GCDB) will build upon survey descriptions of legal land parcels, which are defined by the Public Land Survey System in most States.

The BLM is preparing standards in cooperation with other Federal agencies, including the U.S. Forest Service and the U.S. Geological Survey. The BLM is also participating with other Federal agencies in developing standards for the exchange and sharing of data and for defining spatial data transfer standards. After land parcel data is automated, the BLM will use existing GIS technology to retrieve and display land status records, such as ownership and existing leases, or permits for use and other natural resource information. The BLM recognizes the tremendous benefits of GIS with its faster responses to public queries, the use of better quality data in many decisions, streamlining the processing of cases, and the flexibility in data analysis. Through GIS, the BLM will coordinate land use inventory, planning, and management activities with other Federal agencies, State and local governments, interest groups and industry, and the general public.

FUNDING ECOSYSTEM MANAGEMENT

The BLM is committed to effectively managing sustainable ecosystems in a constrained budget environment. The current budget structure is inflexible and does not facilitate an integrated or coordinated approach to resolving resource issues. The present budget process is also complex and costly to administer; not responsive enough to meet rapidly changing demands; has too many individual sources of funding; and focuses too much on individual programs.

The BLM has proposed a new budget structure that will allow the Bureau to allocate funds on the basis of the BLM's mission rather than on a separate, often conflicting, program-by-program basis. The proposed structure is designed to improve efficiency and reduce costs associated with managing the public lands as well as provide needed flexibility. Fiscal accountability mechanisms and on-the-ground performance measures must be critical components of the new BLM budget structure.

The BLM will not take any action to revise the current budget structure without appropriate Congressional review and approval. Congress will have the opportunity to consider this proposed budget as it considers the 1995 appropriation legislation.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

The ecosystem approach to management is supported by the BLM's enabling legislation. There are, however, several legal, administrative, and cultural obstacles that may impede implementation of ecosystem management.

The principles of ecosystem management require Federal agencies to integrate management actions at various scales including landscape and watershed perspectives. The boundaries of the Forest Service forests' and BLM districts, however, were not drawn to facilitate the accomplishment of ecological objectives. The agencies have developed coordinating mechanisms to initiate interagency efforts such as PACFISH and rangeland reform. Yet, implementation of these efforts are often confounded by the two agencies' differing missions. The BLM and the Forest Service are attempting to integrate administrative processes and planning regulations to streamline interagency coordination. In addition, the agencies are working to employ comparable data standards and resource classification systems to simplify the exchange of information.

Federal agencies are rewarded for achieving targets based on the production of commodities. Other objectives, especially those that are non-consumptive, such as aesthetic and scenic values and some recreation, are sometimes neglected. Since the production of all goods and services is dependent on ecosystem health, BLM's overriding objective will be to maintain naturally diverse and sustainable ecological systems. Local BLM managers must be empowered to base resource allocation and land use decisions on site specific and landscape trends and capabilities. The ability of managers to practice adaptive management will safeguard the ecological integrity of the land and will allow for the long-term production of goods and services from the Nation's public lands.

Implementing an ecosystem approach to managing Federal lands will require the agencies to place a greater emphasis on hiring and training employees proficient in assessing and predicting the effect of management activities on the landscape. The BLM does not presently have employees possessing requisite skills needed for such a task. Scarce skills specialists and experts who can provide the agencies, States, and interested publics with technical information are critical to the implementation of ecosystem management. The BLM will need to have aquatic, range, and forest ecologists; conservation biologists/population geneticists; hydrologists; and soil scientists/geomorphologists. Specialists with specific expertise may be required depending on regional issues. Other required professionals include economists, statisticians, computer scientists, and cultural resource specialists.

The public's expectations and use of Federal lands grow daily. It is the challenge of the BLM to implement management that meets these expectations. The BLM must meet these expectations within the limits imposed by ecological systems and the need to conserve biological diversity and safeguard ecological sustainability.

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DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

ECOSYSTEM MANAGEMENT ACTIVITIES

The U.S. Bureau of Mines (USBM) is a research, development, information, and analysis agency, with a mission to insure mineral supplies to the country at acceptable economic, social, and environmental costs. Although the Bureau has no regulatory or land management responsibilities, it supports agencies with such duties through its knowledge and expertise in applied geosciences and engineering, mineral and material policy and economics, and natural resource modeling and analysis.

The Bureau's Ecosystem Management Program was initiated in FY 1993 following involvement in several endangered species or ecosystem issues such as the Northern Spotted Owl/Old Growth Forests, and the Desert Tortoise. The program's goals are to improve understanding of the interaction between economic activities such as mining and ecosystems; identify management and policy options that can increase the potential for the coexistence of economic activities and healthy ecosystems; and identify opportunities for ecosystem-related research and development.

Several other Bureau programs are directly applicable to ecosystem approaches to the management of public resources. The Environmental Technology Program focuses on the application of existing and near-term technologies to environmental problems such as the inactive and abandoned mines on Federally owned or managed lands throughout the United States. The Mineral Environmental Studies Program is also currently focused on abandoned mine lands, concentrating on a national inventory, screening and categorization methods, and site characterization. Both of these programs will be crucial to an accurate assessment of, and plans to improve many ecosystems, especially in the western States. Several other programs or activities in the Bureau, including Mineral Land Assessment, Advanced Mining, and Materials Research can provide useful inputs or technical support for Federal ecosystem management efforts.

COOPERATION AND COORDINATION

The Bureau's ecosystem and other environmental activities are conducted in cooperation with other agencies or in the context of multi-agency studies, programs or task forces. Examples include: the Eastside Ecosystem Management Project which will bring together many stakeholders to develop ecosystem management plans for Federal lands east of the Cascade Mountains in Washington and Oregon; the Klamath Basin Ecosystem Restoration Project in Oregon and California; a pilot study of the Lolo Creek watershed in Idaho, in which the impacts of mining on a forested ecosystem are being examined; another pilot study examining the same issues in the Soldier Meadow Allotment in Nevada, an arid ecosystem; and studies of threatened plant species in

California. The other agencies involved in one or more of these studies are the U.S. Forest Service, the Bureau of Land Management, the U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, the Bureau of Reclamation, State and local agencies, and various industry and public groups.

In related or supporting work, the Bureau is working with the Terrestrial Ecosystem Regional Research Analysis Lab (TERRA Lab is a multi-agency effort in Ft. Collins CO.) to develop and share analytical tools and methodologies for application to ecosystems problems; an Environmental Protection Agency proposed consortium for site characterization technologies, and another for arid ecosystem research; the Department of the Interior's efforts to inventory, assess and address abandoned mine and hazardous waste sites on Federal lands; a Desert Research Institute study of the effectiveness of intentional and natural re-vegetation following mining in the southwest; the National Park Service on the Voyageurs National Park; and the Corps of Engineers' Topographic Engineering Center on the use of remote sensing in the identification and assessment of human and ecological hazards. In addition to the above, the Bureau is engaged in a number of studies to assist all of the land management agencies in identifying, assessing and recommending action in areas where past mining has created a threat to safety or human or ecosystem health.

The USBM's involvement with the Interagency Ecosystem Management Coordination Group began in mid-1993. The group provides a forum to raise a variety of issues, communicate interests and capabilities to a large group of agencies and individuals, and distribute draft materials quickly and efficiently. It is also a convenient initial contact for those interested in learning about Federal ecosystem activities and policies. Current group activities initiated by the group include an effort to coordinate ecosystem training needs and opportunities throughout the Federal government, and a list of ecosystem terms and concepts that can facilitate future communications among agencies and the public.

TOOLS OF ECOSYSTEM MANAGEMENT

Geographic information systems (GIS) are central to effective implementation of ecosystem management. The USBM is using GIS in its ecosystem studies, and is working to develop ecological/economic analysis capabilities. These analytical tools will assist in anticipating ecological consequences of management decisions such as permitting mines, timber sales, or other economic activities, and help evaluate alternative technologies for development or remediation of past activities. Other tools, including Gap analysis, network analysis, sedimentation and water quality models, remote sensing, and coupled systems models will be used and integrated with GIS to anticipate the consequences of economic activities and the cumulative impacts of one or more activities over time.

Other analytical capabilities available in the Bureau that are being used in ecosystems applications include engineering costing, resource assessment and evaluation, systems dynamics, and economic analysis.

FUNDING ECOSYSTEM MANAGEMENT

The Bureau is currently reviewing its programmatic structure and direction, and recently released a report recommending a series of changes. While not final, it is likely that the Bureau will add emphasis to environmental and ecosystems programs, and encourage more integrative and cooperative efforts with other agencies and groups.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

There are three categories of constraints on future Bureau activities in ecosystems management programs: legal, resource, and organizational. The legal constraint relates to the possible liability resulting from activities on Federal lands under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund). This constraint is not unique to the USBM, and its modification would permit more rapid identification, assessment and resolution of problems already affecting ecosystems. The resource constraint (budget and FTEs) would, if relaxed, allow an acceleration of various activities supporting the ecosystem program, and permit participation in more ecosystem management projects. Organizational constraints refer to the difficulties of implementing multi-agency, multi-objective, interdisciplinary team efforts under current budgetary, personnel, and performance evaluation processes.

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DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ECOSYSTEM MANAGEMENT ACTIVITIES

The Bureau of Reclamation (Reclamation) is in transition. It is moving away from being primarily a water resources development agency to a water resources management agency. As part of this change, the agency is taking a more holistic approach to protecting the environment, focusing on managing projects from an ecosystem perspective and at a watershed/river basin level. This approach is embodied in Reclamation's Strategic Plan which lays out a framework for how Reclamation will manage its projects through the coming decade. As stated in the Plan, Reclamation's mission is "to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American Public."

In his "Blueprint for Reform", Commissioner Dan Beard describes the reorganization that Reclamation is undergoing and the direction the agency will take in revising its programs and policies to better respond to changing public values and resource needs. As part of the reorganization, staff will be reviewing agency policies and guidance, making revisions, developing new guidance, and taking other actions, as necessary, to support Reclamation's resource management objectives, particularly with respect to ecosystem management and protection.

Reclamation is presently examining the reoperation of many of its projects to improve environmental conditions. Some of the more complex projects involve: the reoperation of the Central Valley Project in California, review of system operations on the Columbia River, and reoperation of the Glen Canyon Dam. For these and other projects under its Investigation of Existing Projects Initiative, Reclamation is investigating what additional values may be obtained from changes in water and power operations and how Reclamation can better respond to resource needs. Water conservation, improvements in stream flows and water quality, and ecosystem restoration are primary elements of these investigations.

COOPERATION AND COORDINATION

Reclamation is working cooperatively at all levels with other Federal and State agencies and private entities to address environmental concerns. In each of Reclamation's regional offices, cooperative efforts are underway on particular projects and programs. Several of these are described below.

In our Mid-Pacific Region, Reclamation has teamed up with the Fish and Wildlife Service, National Marine Fisheries Service and the Environmental Protection Agency to form a Federal Ecosystem Directorate, commonly known as "Club Fed", to address the complex ecological relationships and difficult resources management issues associated with the San Francisco Bay and the Sacramento-San Joaquin Delta and to improve interagency coordination on environmental matters. The Mid-Pacific Region is also a participant in California's Regional Strategy to Conserve Biological Diversity.

In our Upper Colorado Region, Reclamation is participating on an interagency team to evaluate actions that could be taken to protect the Middle Rio Grande Ecosystem. In October, 1993, the team published the "Bosque Biological Management Plan".

Our Great Plains Region, along with the U.S. Environmental Protection Agency and the State of Colorado, recently signed an MOU to work together to improve or maintain the aquatic ecosystem of the Upper Arkansas River Watershed.

As part of the System Operation Review for the Columbia River, our Pacific Northwest Region is examining various structures for a regional forum which would be comprised of Federal, State, and Tribal agencies and the public sector to provide input on future management decisions on the Columbia River.

Our Lower Colorado Region is working with the Fish and Wildlife Service to restore a number of backwater wetlands on the Colorado River. This activity will benefit the fishery, the endangered Yuma clapper rail, and species richness.

Reclamation's Denver Technical Center is participating in a group called "The Colorado Ecosystem Partnership" which includes representatives from the Fish and Wildlife Service, Bureau of Land Management, the Forest Service, the National Park Service, the Environmental Protection Agency, and local and State agencies. The purpose of the group is to better coordinate resource management activities for the protection of ecosystems. The two areas that the group are focusing their attention on are: environmental education and ecosystem management. Within the group, teams have been set up to address: Conservation of Biological Diversity, Effects of Resource Management Activities on Local Communities, Ecological Stratification, and Environmental Education. Plans of the group include selecting an area within the State to test how Federal, State and local entities can work together in ecosystem management and protection.

Reclamation and the National Biological Survey (NBS) are in the process of setting up a joint research facility to be located at Reclamation's Denver Technical Center. This facility will be devoted to doing research on the ecological processes and effects of controlled aquatic ecosystems and to developing and testing the technologies which would benefit ecosystem sustainability.

At the Washington Office level, Reclamation is participating in several Interagency and Departmental workgroups that are seeking to address environmental issues on a broader scale and more coordinated manner. These groups are: the Interagency Ecosystem Management Coordination Group (DOI and Interagency), the Interagency Watershed Management and Protection Workgroup, and the Interagency Water Resources Workgroup. The goals of these groups are to improve natural resource management and protection among Federal agencies through collaboration and cooperation at the Federal level and also by developing mechanisms/processes which include State and local involvement.

The process that Reclamation uses in developing cooperative efforts or partnerships, especially at the regional level, varies depending upon the nature of the project or effort, but it usually involves signing a formal agreement, such as a Memorandum of Agreement, which lays out the goals and purpose of the effort, as well as the responsibilities of each of the signing entities. Usually there will be an Executive Council along with smaller working groups to address particular issues. State and local agencies, representatives of the public and other interest groups are normally participants on these groups.

TOOLS OF ECOSYSTEM MANAGEMENT

Reclamation has more than 15 years of practical experience with automated geographic analysis tools. This experience is concentrated in 4 areas: (1) geographic information systems (GIS); (2) satellite image processing; (3) airborne video; and (4) systems integration. GIS is used in Reclamation to supply information for: RMPs (Resource Management Plans), environmental monitoring, consumptive uses and losses calculations, and water spreading issues. Satellite imagery is used to determine vegetation types, to study reservoir water quality, and for mapping basin-wide snowpack. Airborne video is used in analyzing flow-to-habitat relationships for endangered species habitat on western rivers, for monitoring weeds in canal systems, and for mapping areas of overbank flooding. Reclamation's systems integration efforts combine hydrologic models, relational databases, and GIS to examine the potential impacts of different operating decisions on river basin management.

FUNDING ECOSYSTEM MANAGEMENT

Reclamation's budget does not have a line item per se for ecosystem management. Currently, activities associated with ecosystem management are funded out of our Operation and Maintenance and General Investigation program appropriations. Reclamation is in the process of reformulating its budget to reflect its changed mission and the more holistic approach the agency is taking with respect to resource management. Ecosystem management is an area that will benefit from the change in structure. At this point, we do not know how much work will be carried out within the agency or by contractors on activities associated with ecosystem management. Our sense is that most of the activities will be carried out by Reclamation personnel.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

As other Federal agencies, Reclamation is emersed in identifying and prioritizing the actions needed to protect the sustainability of certain ecosystems and what role it and other agencies have in this effort. Because ecosystem management involves interests and actions that cut across all levels of government, as well as the public and private sectors, cooperation and the development of partnerships is the only realistic way to address ecosystem issues. Reclamation will continue to actively pursue the development of these cooperative efforts.

Reclamation has not as yet identified any additional staffing needs in this area. However, we do anticipate developing a training program for selected personnel on ecosystem management.

In so far as any legal restrictions which we may encounter with respect to ecosystem management, Reclamation has been constrained by State water laws on ecosystem restoration projects where water outside the beneficial uses identified by the States is required. An example of this is water for instream flows. Where we have identified additional water needs for ecosystem restoration, we have been working with individual States and water users to try and find ways to meet these needs. This has not been an easy process and has resulted in limited success.

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DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

ECOSYSTEM MANAGEMENT ACTIVITIES

The U.S. Fish and Wildlife Service's (Service) mission is to conserve, protect, and enhance the Nation's fish and wildlife and their habitats for the continuing benefit of the American people. As this mission can only be fulfilled by preventing the degradation of healthy systems and restoring those that have been damaged, it makes sense to adopt an ecosystem management approach.

The Service has prepared a concept document to describe our ecosystem approach to fish and wildlife conservation. Ecosystem management is defined in the Service's concept document as, "protecting or restoring the function, structure, and species composition of an ecosystem, recognizing that all components are interrelated." We are actively seeking the input of our partners at the national and local level to refine and implement the concept. We are also developing a set of principles for this approach; making management changes to facilitate its adoption; and training employees in the concept.

The Service has a wide variety of responsibilities. Our land base consists of over 91 million acres of National Wildlife Refuges, over which are superimposed Wilderness Preservation Areas, Wild and Scenic Rivers, Research Natural Areas, Wetlands of International Importance, and Shorebird Reserves. In addition to administering the vast National Wildlife Refuge System, our responsibilities include: determining what species warrant endangered status, reviewing wetland permits, setting harvest limits, restoring habitats and reintroducing or enhancing fish and wildlife populations, preventing the introduction of environmental contaminants and mitigating their adverse impacts on fish and wildlife resources. These responsibilities require a Service presence throughout the Nation and in the international conservation community. The wide array of our activities is coordinated and enhanced by our ecosystem approach.

The Service is using watershed-based ecosystem units to organize our activities nationwide and set ecosystem-wide goals and objectives for each unit. We are also working with partners in each ecosystem and leveraging our joint capabilities to achieve greater results.

The Service has many programs that work regionally with Federal, State and local partners to leverage dollars and resources to more effectively conserve or restore ecosystems. The Service's Private Lands Program, North American Waterfowl Management Program, Coastal Ecosystems Program, Sport Fish Restoration and Wildlife Restoration programs, Partners in Flight, and Great Lakes Initiative are just a few of our activities geared to creating partnerships in ecosystem management.

The Endangered Species Act states: "The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." The Service is using an ecosystem approach in multiple species listing, such as the listings for plants in Hawaii and California. Recovery planning and implementation likewise have focused on ecosystems: the plans for the desert spring complex at Ash Meadows, Nevada, the Edwards Aquifer in Texas, and scrub habitat in central Florida all cover multiple species in the same habitat facing the same threats.

At a national level, the Service participates in the White House Office of Environmental Policy's Ecosystem Management Task Force, which is addressing the National Performance Review's Ecosystem Management recommendations. The Service is one of the founding members of the Interagency Ecosystem Management Coordinating Group, a group that shares information and serves as a link across agencies working on similar programs. The Service is also involved in implementing the Biological Diversity Convention recently signed by President Clinton.

COOPERATION AND COORDINATION

Strong partnerships are critical to the success of ecosystem-level management, where the scope is so extensive that one agency cannot act effectively on its own. As mentioned earlier, the Service has many national programs, as well as regional programs, that work with Federal, State, local and private partners. These partnerships, by reducing redundancy, increasing cooperation and pooling resources, are key to leveraging resources and enhancing our ability to do more with fewer dollars.

For example, the Fish and Wildlife Service and the Bureau of Reclamation are working with the State of California and other agencies to implement the Central Valley Project Improvement Act. We will restore the entire watershed, rather than develop separate plans to protect each endangered species, fish or other significant resource separately by re-assessing the same areas over and over again.

The Service works with the Bureau of Land Management and other private, State, and Federal partners to protect, enhance, and restore Montana's Centennial Valley. The draft management plan calls for biological data gathering and specific projects by multiple partners to sustain the unique biological and cultural values of the Valley.

The Washington State Ecosystems Conservation Program is an example of Federal and State governments working with Indian tribes, conservation groups and private land owners. So far more than 25,000 acres of wetland and upland habitat and 200 miles of stream have been enhanced or restored through cooperative efforts.

The North American Waterfowl Management Plan is a cooperative effort by the U.S., Canada and Mexico to coordinate wetland conservation priorities and promote joint ventures to conserve vital wetlands in North America. Under the Plan, the Service has worked with hundreds of partners to restore, protect or enhance more than two million acres of wetlands and associated habitat, much of it on private lands. The Plan serves as a practical model of ecosystem planning, with partners working to restore priority wetlands in 12 habitat joint ventures. By relying on ecosystem rather than intensive single-species management, this habitat work benefits the overall conservation of biological diversity while at the same time providing a long-term solution to declining waterfowl populations.

The Service's Fisheries Program works around the country with partners at the Federal, State and local level to restore declining fish stocks such as Atlantic salmon in New England, lake trout in the Great Lakes, striped bass on the Atlantic and Gulf coasts, paddlefish in the Missouri and Mississippi river basins, and Pacific salmonids in the Northwest. Each of these efforts requires close coordination to address interdisciplinary issues affecting population levels, such as harvest, habitat suitability, fish passage, and hatchery supplementation.

The Silvio Conte National Fish and Wildlife Refuge Act authorizes the Service to establish a refuge in the 7.2 million acre Connecticut River Basin, an entire aquatic ecosystem transecting four States and urban, agricultural and natural areas. The conservation infrastructure in the basin is very complex, with hundreds of organizations at the Federal, State, and local level with resource concerns. To gather input from agencies and the public, the Refuge Planning Team has held 27 public meetings and 100 meetings with representatives from over 300 organizations. Workshops will be held later this year to identify alternatives to conserve and enhance the resource values of the basin. It is not a foregone conclusion that the end result will be a National Wildlife Refuge in the traditional sense, but the land-protection concept has provided an important catalyst for basin-wide conservation planning.

The Service's Environmental Contaminants Program has an ecosystem orientation to its prevention and cleanup initiatives. Healthy ecosystems and biological diversity are a function of both habitat quantity and quality. Fish and wildlife, and natural ecosystems that support them, are affected globally by pollutants and toxic chemicals. The Service cooperates with and provides technical assistance to the Environmental Protection Agency, the National Biological Survey, the National Oceanic and Atmospheric Administration and the U.S. Coast Guard in contaminant cleanup and restoration in sites affected by pollutants.

The Service's Coastal Ecosystems Program is the cornerstone of the Service's efforts to conserve coastal ecosystems and their living resources through partnerships with other agencies, the States and the private sector. The individual watershed-based projects integrate all Service activities within specific coastal watersheds and apply an ecosystem approach to correcting resource problems. The program has resulted in the reopening of hundreds of miles of coastal stream habitat to fish passage; restoration of freshwater flows to tidal wetlands; stream buffers; and improved planning and management to consider ecosystem needs.

The Interagency Ecosystem Management Coordination Group (IEMCG) has given Federal agencies an excellent opportunity to exchange information and brainstorm ideas. The group is developing common ecosystem management principles, terminology, interagency training courses, and outreach activities to promote ecosystem management. We can now make decisions based on much more information than if we worked independently.

One of the many IEMCG committees in which we participate is the Ecological Assessment committee. We plan to support a U.S. Forest Service initiative to conduct an interagency national ecoregion-based ecological assessment. The assessment, with assistance from numerous nongovernmental organizations, will synthesize information on the current conditions of the country's major ecosystems, the natural and human-caused actions that have contributed to these conditions, and the ecological trends and alternative futures that can be projected for these ecosystems. This is precisely the information we need to decide which ecosystems are most at risk, to develop management strategies, and to monitor changing landscapes.

TOOLS OF ECOSYSTEM MANAGEMENT

The Service uses geographic information systems (GIS) for many applications. We will discuss only a few of them here.

Our Southern New England Office is involved in a large ecosystem-scale, two-year habitat study of the New York Bight watershed. This study has used state-of-the-art GIS to develop a comprehensive data base of natural resource information, in a form that natural resource decisionmakers can readily use to analyze the status of key species and their habitats in the Bight. This GIS system also assists other Service programs in New England to collect, digitize, store, analyze, and graphically display a large volume of data on the geographic distributions, population status, and habitats of several hundred species of regional concern. One particularly large project encompasses the four-State 7.2 million acre Connecticut River watershed. With the aid of a computerized GIS, these data are being used to identify "hot spots" in the drainage basin, which will become potential acquisition sites for the Conte National Fish and Wildlife Refuge.

The Delaware Bay Estuary Program has used U.S. Forest Service satellite imagery to map forested areas on the Delaware River coastal plain. Overlying data that describes the aspects of forests needed by nesting neotropical migrant birds, the Service can target areas for acquisition and land use restrictions.

Our Alaska refuges have developed extensive GIS programs, where satellite imagery and GIS used to map habitat and estimate wildlife populations have enabled the Service to more effectively manage fires and protect sensitive wildlife areas.

The Charles M. Russell National Wildlife Refuge (CMR) in Montana now has over 30 data layers, which were acquired or developed in cooperation with other Federal agencies, the State and the Gap analysis has project. CMR coordinates with over 20 State and Federal groups using GIS in Montana and assists with development of GIS data standards, exchange of spatial data, and data conversions. CMR recently produced GIS composite maps that were the basis for evaluation of appropriate reintroduction sites for black-footed ferrets on Bureau of Land Management and tribal lands.

The Service is also a member of the California Executive Council, a multi-agency group dedicated to designing a statewide strategy to conserve biological diversity. Working with Gap analysis, the Service has mapped coastal sage scrub and other endangered species habitat areas, and combined them with layers showing jurisdictions and land use in order to rank habitat types and make recommendations for future preservation efforts.

The North American Waterfowl and Wetlands Office has created GIS data layers for the joint ventures of the North American Waterfowl Management Plan and projects funded through the North American Wetlands Conservation Act.

The Service's National Wetland Inventory (NWI) generates information on the characteristics, extent, and status of the nation's wetlands. Computer operations in St. Petersburg, Florida allow NWI to construct the wetlands layer of the National Spatial Data Infrastructure, leading to the production of customized maps and the transfer of data to cooperators nationwide. About 15% of the United States' wetlands maps has been converted into digital data for computer use.

FUNDING ECOSYSTEM MANAGEMENT

Our current budget structure is structured to be functionally consistent with the organization. We have completed ecosystem project descriptions that are cross-referenced to our programs to facilitate congressional understanding of our ecosystem initiatives. The Service is proposing to implement an ecosystem approach using the existing budget structure. After one year of implementation, we will reevaluate our approach and reconsider the need to restructure the budget or the organization.

The Service is briefing Congressional staffs to explain the Service's move to an ecosystem approach. The FY 1995 budget will highlight some priority ecosystem projects; however, Service programs will continue to be presented along functional lines.

We anticipate that most of our coordination with partners will be done by Service staff in the field. Actual, on-the-ground ecosystem restoration or conservation work may be done by contractors, or by our field staff in concert with other partners, depending on the nature of the work and the available agency expertise. At this stage, it is too early to anticipate exactly what portion of the work will be carried out by contractors. We strive to take the most cost-effective route and meet legal requirements on hiring private-sector and minority contractors.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

Limited funds and staff dictate the need to find approaches such as ecosystem management that can increase our effectiveness and efficiency. The Service will prioritize ecosystems in order to concentrate personnel and resources in those areas most important to protecting the Nation's biological diversity. We recognize that some areas are more important than others, as reflected in our Land Acquisition Priority System and the identification of focus areas or hot spots over the last decade. While there will continue to be Service activity in all parts of the country, budget increases and shifting of resources will be directed to high-priority Ecosystem Units where the Service has the greatest likelihood of using our capabilities and tools, in partnership with others, for the greatest benefit. The process of identifying Ecosystem Units of highest emphasis will be participatory and involve our partners. Service priority-setting will recognize the need for different types of ecosystem goals, ranging from protection of pristine areas, to restoration of highly degraded areas, to crisis intervention.

The Service's mission can be better achieved through ecosystem management. The Service can address its responsibilities by working within ecosystem units to join with others to achieve common goals for fish and wildlife conservation. We have all the authorities and the programs we need to participate in ecosystem management.

We envision that our future role in ecosystem management will be as a member of many diverse and varying management teams, upholding our mission to conserve, protect and enhance the Nation's fish and wildlife and their habitats. We will contribute our expertise, personnel and funding within ecosystems whenever and wherever they can be of benefit.

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DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE

ECOSYSTEM MANAGEMENT ACTIVITIES

The primary responsibilities of the Minerals Management Service (MMS) are to manage the mineral resources located on the Nation's outer continental shelf (OCS), collect revenues from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues. To accomplish these responsibilities, the Offshore Minerals Management Program administers the OCS competitive leasing process and oversees the safe and environmentally sound exploration, development, and production of offshore natural gas, oil, and other mineral resources. The MMS Royalty Management Program provides for the efficient, timely, and accurate collection and disbursement of revenues from mineral leasing and production. Revenues are distributed to Indian tribes and allottees, States, and the U.S. Treasury.

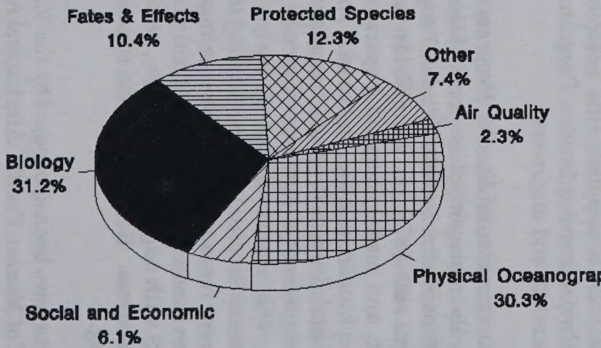
Protection of the environment and operational safety are of primary importance in all OCS leasing and lease management decisions. The MMS manages the offshore natural gas, oil, and marine mineral industries through the establishment of environmental standards in regulations and lease stipulations. These standards are enforced through review of exploration and development plans and permit applications, and a rigorous program of inspections. To accomplish this enforcement, the MMS depends upon its extensive Environmental Studies Program, engineering studies, and technical staff of scientists and engineers.

The Environmental Studies Program was initiated in 1973 to support the OCS minerals management responsibilities of the Department of the Interior. The goal of the Environmental Studies Program, as stated in the OCS Lands Act Amendments of 1978, is to provide information needed for prediction, assessment, and management of impacts from offshore mineral development activities on human, marine, and coastal environments. Since its inception, the Environmental Studies Program has supported approximately $600 million in marine environmental and socioeconomic research and data collection. The figures in the chart on the following page show percentages of total Environmental Studies Program funding through FY 1993 by OCS Region and topic. Current research efforts focus primarily on providing information needed for decisions concerning operational activities in areas of the Gulf of Mexico and Pacific OCS with ongoing exploration, development, and production of offshore mineral resources. Research is also conducted in areas with scheduled future OCS leasing.

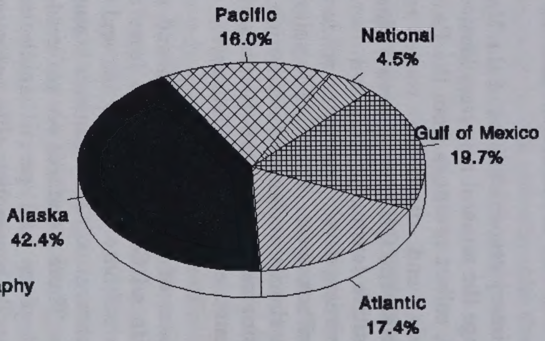
Projects have been sponsored by the MMS Environmental Studies Program in the Gulf of Mexico, Pacific, Alaska, and Atlantic OCS and coastal areas. Most of these projects may be generally described by the following categories.

OCS Environmental Studies Program

Fiscal Year 1973 to 1993



Total by Selected Topic



Total by Region

Air Quality

The objectives of these studies are to characterize and quantify emissions of air pollutants generated on the OCS, to examine the transport and dispersion of these emissions in the atmosphere, and to evaluate their effects on air quality onshore.

Biology

Investigations of the sea bed and the organisms inhabiting it (benthic ecology), fisheries, non-protected marine birds and other species, and marine ecological monitoring are included in this category of studies. Beginning in FY 1994, the newly created National Biological Survey (NBS) of the U.S. Department of the Interior will be responsible for conducting most of the biological research identified by MMS for support of OCS decisionmaking. The MMS will continue to administer the biological and interdisciplinary marine ecology studies which are site-specific and directly applicable to operational approvals or to the monitoring of OCS gas and oil activities.

Fates and Effects

The fates and effects investigations are primarily interdisciplinary studies of the physical-chemical and biological processes that affect spilled oil and the impacts of oil and gas drilling and production discharges, spilled oil, and oil dispersants on biological communities.

Protected Species

Unique protection of all marine mammals in U.S. waters is provided by the Marine Mammal Protection Act of 1972. The Endangered Species Act of 1973 provides additional protection to threatened and endangered marine mammals, birds, turtles, and other listed species of plants and animals. Federal agencies are required to ensure that actions they conduct, fund, or authorize will not jeopardize the continued existence of listed species or adversely modify their critical habitats. These acts require MMS to meet special information needs, including the collection of data pertaining to the distribution and interrelationships of species protected under these acts, and the determination of the potential effects of OCS natural gas and oil activities on these species.

Physical Oceanography

The broad objective of these studies is to provide an understanding of the dynamic processes of the ocean and the features that control the motion of the coastal and oceanic waters of the continental shelf. These studies support modeling efforts for oil spill risk analysis and provide information important to the interpretation of processes affecting biological populations and communities in the marine environment.

Social and Economic

This category includes economic modeling efforts conducted to support the 5-year comprehensive offshore natural gas and oil leasing plan, research to describe the economic and social systems of coastal residents, and research to characterize and monitor the complex interactions between the economic and social systems and activities impacted by and associated with the offshore natural gas and oil industry.

Other

Special studies and analyses are designed to provide coverage of issues related to the offshore natural gas and oil program that do not appropriately fall into the topics described above. Examples include information management and dissemination, support of scientific conferences, information summaries and analyses, and reviews of the Environmental Studies Program by the National Academy of Sciences (NAS).

The MMS Environmental Studies Program has produced a wealth of information that is available as a base for marine and coastal ecosystem management efforts. In its review of the ecology component of the Environmental Studies Program, the NAS concluded that one of the Program's major achievements is the characterization of marine mammal and bird populations and benthic habitats of the U.S. continental shelf, including analysis of benthic fauna and the associated physical and chemical parameters. In addition, the Environmental Studies Program has produced a major information base for social and economic systems of coastal areas, especially in Alaska.

COOPERATION AND COORDINATION

From its inception, the Environmental Studies Program has worked hard to maximize cooperative efforts with other Federal programs involved with marine environmental research and data collection. The MMS has provided cooperative funding for many projects conducted by other agencies with missions involving specific components of marine ecosystems. The MMS is currently working closely with the Office of Naval Research and the Naval Research Laboratory to identify research areas of mutual interest for future cooperative efforts. Cooperative efforts with other Federal agencies, primarily the National Oceanic and Atmospheric Administration, Department of Energy, U.S. Fish and Wildlife Service, and the U.S. Geological Survey, have accounted for nearly 36 percent of the total Environmental Studies Program funding.

The MMS also has emphasized coordination of its marine environmental and socioeconomic research and data collection efforts with State and private sector activities. The University Research Initiative (URI) and the Coastal Marine Institute (CMI) programs are major components of the Environmental Studies Program which emphasize this concept. In both the URI and the CMI, the MMS collaborates with research scientists in the university community to identify research efforts that will address some of the still unanswered questions associated with offshore oil and gas development impacts.

Through a sense of shared goals, and shared understanding of what the problems are and how they can be studied, the CMI and URI have increased academic community involvement in design and conduct of the studies. Through the CMI program, MMS funds are combined on a one-to-one basis with funds provided by the participating universities and States to carry out a mutually agreed upon research agenda that might otherwise be unattainable. An important aspect of the CMI is that the agreed upon research agenda represents consensus between the State and MMS on the most important OCS issues that need to be researched. As stakeholders in the CMI, all participants will have enhanced access to the research results which will facilitate the use of good science in subsequent resource management decisions. Additionally, the CMI emphasizes providing information to local users and providing for education and training of students in academic fields relevant to OCS issues.

The MMS participates in many interagency coordination efforts including those involved in marine environmental research, ecosystem management, global change, biodiversity, and management of natural resources. The Interagency Ecosystem Management Coordination Group (IEMCG) has provided MMS with an additional forum to enhance the general awareness of Federal agencies with ecosystem management missions to the wealth of marine environmental and socioeconomic information collected by the Environmental Studies Program. Collaboration among the diverse agencies participating in the IEMCG will promote the implementation of ecosystem management principles to ongoing and future Federal resource management and environmental protection programs.

TOOLS OF ECOSYSTEM MANAGEMENT

The MMS is in the process of developing a geographic information system (GIS) as part of its agency-wide Technical Information Management System. Spatial information in the MMS Environmental Studies Program Information System will be linked to that GIS. To facilitate incorporation of spatial data to GIS, the Environmental Studies Program now requires that researchers adhere to the Federal Geographic Data Committee's spatial metadata standards. A GIS capability has been developed through the MMS Environmental Studies Program at Jackson State University and some practical experience with GIS application has been gained in the MMS Gulf of Mexico Region.

FUNDING ECOSYSTEM MANAGEMENT

All of the research and data collection efforts supported by the MMS Environmental Studies Program provide information applicable to marine and coastal ecosystem management. Consequently, the current budget structure does accommodate aspects of ecosystem management relevant to the MMS mission. Further implementation of ecosystem management concepts and principles would require budget growth. In FY 1994, \$4.5 million of the MMS base budget was transferred to the NBS budget to support biological research identified by MMS. The \$4.5 million is to be carried annually by NBS as a minimum funding level required to conduct MMS biological research.

The MMS does not maintain its own laboratories, research vessels, or other research facilities. Virtually all of the MMS research and data collection efforts are conducted by external groups including academic institutions, private consulting firms, and State and Federal agencies. The MMS has developed a comprehensive planning process to identify environmental and socioeconomic issues relating to OCS oil and gas development. The MMS scientific staff designs the research efforts, provides technical oversight during the conduct of the research, and interprets and synthesizes the scientific information for use in resource management decisions.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

Problems of insufficient staff or legal restrictions are not identified for MMS with respect to ecosystem management efforts. The MMS plans to continue its emphasis on interagency coordination, partnerships with States, and cooperative funding of marine and coastal environmental research and data collection efforts. As a mission-oriented resource management agency contributing a substantial information base to ecosystem management efforts, the MMS will work to enhance the broader availability of the information produced by its Environmental Studies Program. One avenue for future MMS research is a focus on long-term, interdisciplinary studies of site-specific environmental issues. Emphasis of such studies would be on process-oriented research investigating the chronic impacts of OCS natural gas and oil activities on ecosystem structure and function.

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DEPARTMENT OF THE INTERIOR
NATIONAL BIOLOGICAL SURVEY

ECOSYSTEM MANAGEMENT ACTIVITIES

The National Biological Survey (NBS) was established in FY 1994 through the transfer and consolidation of biological research and monitoring programs from seven bureaus within the Department of the Interior (DOI). The mission of the NBS is to provide leadership in gathering, analyzing, and disseminating the biological information necessary to support the sound management of the Nation's natural resources. Central to the vision that guided establishment of the NBS is the need for a strong, coherent, ecosystem-oriented biological science base to assist decisionmakers in the complex task of ecosystem management.

In establishing the NBS, Bruce Babbitt, Secretary of the Interior stated:

> The National Biological Survey will produce the map we need to avoid the economic and environmental 'train wrecks' we see scattered across the country. NBS will provide the scientific knowledge America needs to balance the compatible goals of ecosystem protection and economic progress. Just as the U.S. Geological Survey gave us an understanding of America's geography in 1879, the National Biological Survey will unlock information about how we protect ecosystems and plan for the future.

It is important to emphasize that NBS is a non-regulatory agency and does not have natural resource or ecosystem management authorities or responsibilities. Instead, the role of NBS is one of gathering, analyzing, and reporting information as well as improving the accessibility of information to others. It is the biological and ecological sciences arm of the Department of the Interior. As an impartial, scientific organization, NBS is a non-advocacy agency whose greatest contribution is the provision of sound, accurate, and credible information regarding the types, condition, and functioning of the Nation's biological resources and ecosystems.

Since NBS was initially constituted by combining individual programs and activities from seven Interior bureaus, the initial task has been to begin structuring the consolidated activities and capabilities in a manner that will be responsive to ecosystem management needs. To accomplish this, the NBS is establishing four geographically based "Ecoregional Offices" to serve the Western, Mid-Continent, Southern, and Eastern Ecoregions. These Ecoregional Offices are responsible for coordination and communication with local managers and decisionmakers regarding information needs. In addition, the Ecoregional Offices have line management and supervisory responsibility for the Centers and Field Stations located within the Region and individual Centers have primary mission responsibilities for specific ecosystems. This structure allows continued implementation of National programs and NBS initiatives through guidance from headquarters and delegated authority to the Ecoregional Offices while providing improved responsiveness to local management needs.

The biological research and monitoring activities consolidated into NBS from the seven DOI bureaus tended to be resource specific (e.g., species or habitat type) due to the legal mandates of the bureau from which they originated. Structuring of these activities into programs that support ecosystem management will not result in the termination of such ongoing activities. Rather, consolidation of the activities into a single bureau allows their integration into a more holistic program addressing management needs. In addition, such consolidation provides opportunities for improved efficiency by reducing redundancy and improving coordination. The changes involved in moving towards support of ecosystem management therefore deal more with how the work is done than with what is done. Much of the same information needs to be gathered but it needs to be done in a much more integrated fashion.

COOPERATION AND COORDINATION

In advising the Secretary of the Interior on the formation of the NBS, the National Research Council of the National Academy of Sciences recommended the following:

> ...the National Biological Survey will be a critical first step toward assembling a comprehensive assessment of the nation's biological resources. However, to achieve the best possible results, there must be a coordinated national effort that draws on existing programs and strengths at all organizational and jurisdictional levels. The work of the NBS must be integrated with the continuing efforts of other relevant Federal agencies, State surveys, museums, academic institutions, and other entities.

This recommendation not only acknowledges, but strongly emphasizes, that assembling the information necessary for assessing the Nation's biological resources and ecosystems is not an activity that is doable, or even appropriately done, by a single agency. Instead, the role of NBS is to serve as a catalyst for the organization and distribution of biological and ecological information. This is an enormous task which can only be accomplished through the establishment of partnerships with other Federal, State, and local agencies involved with inventorying, assessing, and managing biological resources. Toward that end, NBS is actively developing memoranda of understanding (MOUs) and cooperative agreements with Federal and State agencies with the goal of establishing improved mechanisms for organizing and sharing data and for developing common standards and protocols to ensure data comparability. In addition to these agreements, NBS is actively pursuing MOUs with private sector partners to further increase the base of scientific knowledge about biological and ecological resources. Recent examples of such agreements include MOUs with The Nature Conservancy and the Association of Systematics Collections.

As the biological and ecological sciences arm of the Department of the Interior, the NBS also serves the specific research and monitoring needs of the Department's bureaus. These needs include information on the structure, functioning and responses of biological resources and systems under the management authority of the bureaus. Drawing upon information gathered by NBS research and monitoring activities and those gathered by the growing network of partnerships, NBS and its cooperators will be able to respond to information needs ranging from those that are national in scale to local and site-specific needs.

Forums such as the Interagency Ecosystem Management Coordinating Group are central to the ability of NBS to identify information needs necessary for effective ecosystem management, to communicate findings, and to assist in coordination of data gathering and sharing. The group can provide a valuable role in helping to coordinate and develop ecosystem management programs and initiatives through the joint identification of needs and communication of programs between information users and providers. Further, with the proliferation of coordinating bodies dealing with a broad range of interagency activities such as research, monitoring, data standards and protocols, sampling and analysis protocols, information networks, etc., the group can help to ensure that these various bodies are aware of, and consider ecosystem management needs in their deliberations and activities so that information gathered for other, worthwhile purposes also will contribute directly and compatibly to the knowledge base that will be required for ecosystem management.

TOOLS OF ECOSYSTEM MANAGEMENT

The Gap Analysis Program was initiated in 1988 by scientists transferred to NBS and continues to be developed by NBS in cooperation with State agencies, the State Heritage Programs, other Federal agencies, and the private sector. This program and its associated geographic information system (GIS) is one of several such capabilities housed within the NBS and applied to a broad range of research and monitoring efforts through the Centers, Field Stations, and Cooperative Research Units. NBS scientists are using GIS as a tool for data organization, integration, analysis, and display in all phases of research, inventory, and monitoring. Examples include development of statistically based sampling plans, predictive modeling, habitat identification, trend analysis, and wildlife tracking.

More specifically, Gap analysis work to map terrestrial species distribution is currently underway in 30 States and planned for expansion into the remaining States by the end of the decade. Similarly, work is beginning on the development of an aquatic Gap analysis as well. Detailed vegetation maps are also being developed for National Parks at a scale sufficient to aid in site-specific park management needs and a prototype program to similarly monitor and map park ecosystems is currently being tested. GIS is commonly used to display and interpret results from the Breeding Bird Survey, and the Biomonitoring of Environmental Status and Trends Program is currently developing a data management system that will allow mapping of contaminant presence and effects across Interior lands.

FUNDING ECOSYSTEM MANAGEMENT

The NBS has a budget structure that is designed to be responsive to ecosystem management needs. As described earlier, NBS is physically structured on an ecoregion basis so that expertise, capabilities, and coordination can be better enhanced and focused on local management needs. In implementing its FY 1994 budget, NBS is emphasizing the initiation of "Ecosystem Initiatives" that will help bring increased funding, research, and monitoring to specific ecosystems under stress. Examples of such initiatives include South Florida, where NBS is helping to organize information and science efforts, and California, where a recently signed MOU established a partnership to fill regional research needs relative to the Endangered Species Act in a multi-species context. Similar efforts are underway in the Southern Forested Wetlands, the Opequon Watershed, and in the Rocky Mountain National Park.

In its FY 1995 budget request, NBS is expanding this approach by recommending additional Ecosystem Initiatives aimed at Pacific Northwest Forests and Watersheds and further increases to the South Florida Initiative which began in FY 1994. All of these Ecosystem Initiatives are intended to strengthen and enhance the partnerships of local, regional and national agencies already addressing the management of these ecosystems. Similarly, NBS is proposing increased funding in FY 1995 for data and information partnerships, much of which will have an ecosystem focus. In addition, the FY 1995 budget request proposes increased resources for "Tactical Research" which is short-term, local research identified by land or resource managers as necessary to make immediate resource management decisions.

A basic operating premise of the NBS budget structure is, therefore, the need for the bureau to be responsive to changing management needs and priorities of the agencies served by NBS. Establishment of the Tactical Research funding category allows for quick response to management issues or crises while longer-term research and monitoring initiatives are identified and developed as needed for the ecosystem of concern. Under previous budget structures, it was extremely difficult for research to respond to "crises" due, in part, to the 2 or 3 year lead time necessary to incorporate the need into the budget process, and to the problems associated with reprogramming a budget dominated by salaries for permanent, full-time employees.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

The NBS recognizes three major challenges in providing information in support of ecosystem management. These challenges are:

- Identification and Delivery of Existing Information. A wide range of information exists about the biology of any given region in various agencies and institutions. Locating this information, and creating the institutional arrangements to make it available in a format that enhances understanding of the region as an ecosystem, is a major role NBS will seek to fulfill.
- Using Existing Information to Assess Future Needs. Regional science and research agendas -- based on input from all interested parties and on a full assessment of what is known -- are key to efficient use of scientific resources.
- Understanding the Components, Condition, and Functioning of Specific Ecosystems. Clearly, gaps exist in both our understanding of overall ecosystem structure, function, and dynamics, and in our understanding of the causes of, and solutions to, specific problems generating public, regulatory or scientific attention. NBS's extensive scientific resources must be directed at both kinds of questions.

The NBS goal of assembling needed information on the nation's biological resources and their ecosystems is founded upon the establishment of partnerships for better science. Fundamental to this goal is the development of a National Biological Information Infrastructure that provides access (dial-in and Internet accessible) for all interested government and non-government entities having use for this information in carrying out ecosystem management efforts. Development of an information infrastructure containing credible, quality-assured biological data is in line with the President's initiative for spatial data to analyze and respond to environmental, economic, and social issues, and for development of computerized information networks. The rate at which the Biological Information Infrastructure is developed is constrained, of course, by the amount of resources available to build it. NBS will continue to develop the infrastructure as rapidly as possible within available resources.

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DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

ECOSYSTEM MANAGEMENT ACTIVITIES

Although the phrase "ecosystem management" has come into vogue only recently, the National Park Service (NPS) mission has guided NPS programs along ecosystem management principles for decades. NPS attitudes toward exotic species, natural fire, coastal barrier islands, bear-visitor interactions, animal population regulation, insects and diseases, vegetation restoration, natural and cultural landscape dynamics, ethnographic relationships, appropriate visitor uses of parks, inter-organizational cooperation, and biosphere reserve cooperatives all have their underpinnings in an ecological approach to management. These ecological underpinnings occur both in broad policy and specific programs.

In the broad policy arena, NPS views ecosystem management to be a philosophical approach that respects all living things and seeks to sustain natural processes and the dignity of all species and to ensure that common interests flourish. This view recognizes that humans are integral parts of the natural world, that human well-being depends on resources produced by the natural world, and that the natural world must be preserved and perpetuated if the human community is to sustain itself indefinitely. In applying this view of ecosystem management, NPS focuses the resource manager's attention on:

- understanding the natural and cultural resource dimensions of a situation before making a management decision;
- understanding the environmental and human consequences of management options before adopting a decision;
- identifying what human values are to be obtained through the taking of management action;
- selecting management actions that achieve the desired human values without irreversible or significant loss of natural or traditional cultural resource components;
- monitoring the results of adopted actions to determine whether or not expectations of consequences and benefits were correct;
- conducting this decision-making process and implementing actions through voluntary partnerships at scales appropriate to the questions being addressed; and
- increasing NPS involvement with all affected human interests in adjacent human communities to achieve by consensus or compromise rather than by confrontation results that provide for the sustainability of all natural and cultural resource elements within the affected biogeographic scale.

NPS believes parks and other protected areas can anchor the ecosystem management process in landscapes by providing places that sustain relatively undisturbed natural and traditional cultural elements. Given this anchor, humans can use the remainder of these landscapes in ways consistent with their ecological attributes and the complementary partnership roles the uses can contribute to ensuring the sustainability of the entire landscapes.

As a partner in ecosystem management, the NPS will continue to implement and enhance its existing management policies through programs that:

- increase the professional skills and capabilities of NPS personnel;
- conduct the inventory, monitoring, and research needed to provide information about park resources;
- assure that general management plans, resource management plans, and sustainably designed development are based on sound scientific information;
- involve the public both directly and through cooperative, voluntary partnerships in assessing management alternatives, commenting on planning efforts, and conducting inventory, monitoring, research, and management programs; and
- monitor the results of individual and cooperative management actions to assess their effects on the sustainability of natural and cultural resources.

The NPS recognizes that ecosystems can range from small to large, depending on the human purposes that lead to their identification. Each described ecosystem will have inherent environmental consistency because it will have been determined by the natural and traditional cultural characteristics of the resource as well as by the human value systems involved. Based on biosphere reserve experiences, NPS believes that it often is more appropriate for the participants in an ecosystem to develop a fluid "zone of cooperation" rather than a rigidly bounded "entire ecosystem".

Within the Scale of a Single Park

Most park managers conduct activities that reflect an ecosystem approach to park management. Park programs designed on the basis of ecological principles include efforts to restore natural fire processes; restore disturbed areas with native plants of local origin; manage pests in an integrated fashion; provide boardwalks for human access to ecologically sensitive areas; or provide public transportation to reduce the number of vehicles traveling through sensitive animal habitats.

Participation in Landscape Scale Cooperative Programs

A long-standing landscape scale ecosystem program is the Greater Yellowstone Area, which evolved from a jointly held management purpose of preventing the loss of the grizzly bear from the landscape into today's focus of both maintaining ecological features necessary for the survival of the bear and finding sustainable solutions to competing demands for use of the ecosystem's resources.

A more recent landscape scale program is the cooperative effort in the Mammoth Cave National Park area to address the effects of regional land use and development on surface and groundwater resources within a zone of cooperation defined by the groundwater recharge area for the park's cave waters.

A currently developing consensus among Federal, State, and some private entities on the desirability of not losing the resources of Everglades NP is spurring a concerted multi-organization effort to develop an ecosystem restoration program for South Florida. This effort has created a South Florida Ecosystem Restoration Task Force of high level federal managers, a South Florida Working Group of Federal bureau managers, and sub-groups for science, management, and infrastructure. The existing interagency organization is seeking to attract the State of Florida and the South Florida Water Management District as additional partners.

Regional Scale Partnerships

One example of a regional scale partnership, the Southern Appalachian Man and the Biosphere Cooperative, evolved from a biosphere reserve that originally included Great Smoky Mountains NP, the Coweeta Hydrologic Laboratory of the Forest Service, and the Oak Ridge National Environmental Research Park of the Department of Energy. Over time, Mount Mitchell State Park and Grandfather Mountain became biosphere reserve units; the Fish and Wildlife Service, Economic Development Administration, Tennessee Valley Authority, Environmental Protection Agency, and Geological Survey joined; the partnership established a zone of cooperation to encompass southwestern Virginia, eastern Tennessee, western North Carolina, northern Georgia, northwestern South Carolina, and northeastern Alabama; State agencies explored joining; and the partnership established a nonprofit foundation to enlist other organizations as partners.

This partnership now supports a model community planning program to show compatibility of tourism-based development and conservation of natural resources; provides education about threatened and endangered species, dogwood anthracnose, and other environmental concerns; develops environmental education programs and a program directory; supports forest health monitoring; and conducts resource management workshops and planning meetings.

An example of a developing regional partnership is the several year effort of the more than 20 National Park System units that occur within the Colorado Plateau to share information, develop cooperative programs based on the ecology of the area, and seek partnerships with interested organizations. The potential zone of cooperation for this partnership includes southwest Colorado, southeast Utah, northeast Arizona, and northwest New Mexico.

A State of California initiated program, the California Biodiversity Council, is a third example of a regional ecosystem partnership involving NPS, in this case a regional office and its California units of the National Park System. This

State and Federal partnership seeks to apply ecosystem principles to land planning and resource management in each of California's bioregions to prevent further loss of plant and animal species of concern.

National Scale

Exotic species occur in a given place as a result of direct or indirect, deliberate or accidental actions by humans, not as a result of natural evolution. Populations of exotic species threaten natural ecosystems because of their potential, like cancer cells, to grow unchecked and thus disrupt the natural balance among the native species that have evolved together in concert with natural ecological processes. At the national scale of ecosystem management, NPS implements its exotic species policy through a comprehensive, park-based program of inventory, research, monitoring, management, and education. In conducting this program, NPS seeks partnerships wherever possible, including research on management methods, conducting management actions, and informing people about the concerns that exotic species pose for park resources. Other national scale programs include the NPS air resources program and NPS contributions to recovering threatened and endangered species.

Global Scale

NPS contributes to elements of "global ecosystem management" through a variety of partnerships. Examples include international cooperative training and information exchange; bilateral programs with parks and equivalent reserves in other countries; partnership in the international biosphere reserve network and the Man and the Biosphere Program; contributions to U. S. acid precipitation and global change research programs; membership in the Partners in Flight program to prevent further decline in neotropical migratory bird populations; and monitoring deposition of marine debris on marine shores of the United States.

Ecosystem Management Mission Statement

The NPS has not yet developed a specific ecosystem management mission statement. In developing such a mission statement, NPS will draw from the purpose statement of its Organic Act (to conserve the scenery and the natural and historic objects and the wild life therein and provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations) and from key elements of its existing Management Policies regarding relationships to regional environments, working cooperatively with others, taking an encompassing definition of natural and cultural resources and values, managing with a concern for fundamental ecological processes and integrity as well as for individual species and features, and reflecting informed concern for the contemporary peoples and cultures traditionally associated with park resources.

COOPERATION AND COORDINATION

The NPS cooperates extensively at all levels of its organization. Individual parks cooperate with neighbors in fire management, law enforcement, back country management, interpretation, environmental education, and planning. Regional offices cooperate with their Federal counterparts, with appropriate State organizations, and with non-governmental organizations. The Washington Office cooperates with headquarters offices of Federal counterparts, States, and non-governmental organizations.

Cooperation at any level can occur informally or through formal agreements, such as memoranda of understanding, cooperative agreements, interagency agreements, intergovernmental personnel act agreements, or contracts. Examples of existing participatory activities that can influence ecosystem management include the National Interagency Fire Center, Partners in Flight, biosphere reserve cooperatives, the National Water Quality Assessment Program, the Southern Appalachian Mountain Initiative regarding air quality, the California Biodiversity Council, and the Florida Exotic Pest Plant Council. This cooperation is coordinated with State and private sector efforts through agreements; mutual involvements in each other's planning, regulatory, and management development processes; and periodic consultations. As an original, ad hoc member of the Interagency Ecosystem Management Coordination Group, NPS has contributed to the group's charter, program, and activities and welcomes the communication, coordination, cooperation, and interorganizational program development the group provides to the Washington offices of the participating organizations.

TOOLS OF ECOSYSTEM MANAGEMENT

The NPS has a substantial need to maintain park geographic information systems (GIS) program capabilities, coordinate GIS activities, and set standards and policy. NPS is meeting this need by establishing field technical support centers that will be based in parks, regional offices, or university units. These centers will support the more than 100 parks that already have operational GIS systems with operators and will assist the more than 100 additional parks that already have data bases awaiting installation into a GIS or that are planning to develop and install such data bases. Parks use their GIS systems for such activities as park and facility planning, locating inventory and monitoring sites, managing exotic species, determining appropriate locations for poacher interdiction, and developing fire management plans.

In a number of cases, park-focused GIS capabilities are being broadened through cooperative arrangements that make the parks partners in landscape scale efforts. One such partnership involves Shenandoah NP developing GIS information records about natural and cultural resources of park and immediately adjacent lands to facilitate cooperative land use planning with adjacent management jurisdictions and to support formulation of interagency long range protection strategies. Another partnership involves Delaware Water

Gap NRA, the Delaware River Basin Commission, and North Carolina State University in an effort to develop watershed GIS models that will help the Commission meet its responsibility regarding regulations for special protection waters.

FUNDING ECOSYSTEM MANAGEMENT

The NPS budget process combines park operating needs with external coordinating and assisting activities. The structure of this process makes it easy internally to add any pieces specifically necessary to advance NPS contributions to ecosystem management partnerships. The presentation of NPS requests in the President's Budget also easily can accommodate ecosystem management needs identified by NPS or by interagency cross-cutting exercises by incorporating those needs into appropriate subactivities of the Park Management Activity of the Operation of the National Park System Appropriation; the Recreation Programs, Natural Programs, Cultural Programs, and Environmental Compliance and Review Activities of the National Recreation and Preservation Appropriation; Line Item Construction, Planning, and General Management Plans Activities of the Construction Appropriation; and the Land Acquisition and State Assistance Appropriation. As a result, there is no apparent need to restructure the NPS budget to accommodate ecosystem management.

Given the large number of unmet planning and resource needs NPS has identified in its general management plan, resource management plan, professionalization of the resource management work force, and resource management and assessment program processes, NPS focuses both on responding to immediate threats to the survival of park resources and on installing the inventory, monitoring, and management capabilities necessary for providing early warning of, and effective response to, future potential threats. Over a long time period, priorities given to individual ecosystem management programs likely will change as existing programs achieve key planning and program objectives, resource monitoring reveals newly emerging problems, and ecosystem management partners identify their changing needs for NPS participation.

NPS regularly conducts its resource programs through a variety of channels that include employees, volunteers, contractors, and cooperators. Employees and volunteers generally conduct the recurring activities such as interpretation, monitoring, or mitigation; cooperators participate in either recurring or one-time activities such as monitoring, inventory, or mitigation; and contractors mostly perform one-time activities or recurring but highly technical activities such as providing quality assurance for chemical and instrumentation aspects of the air quality monitoring program. The relative mix of these performers changes as the nature of NPS activities change.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

Partnership, identification of common goals, and development and sharing of information form the basis for effective ecosystem management. NPS would like to see functional and broadly participatory partnerships developed for the landscapes that contain National Park System units representative of the nation's natural and cultural resource heritage. To achieve this desired future, NPS will need additional, and more highly trained, personnel, additional resource information, and greater funding as identified through the resource management planning process, both to conduct its own in-park activities and also to carry out its share of the partnership activities that are necessary for partnerships to function.

To be a truly effective partner, NPS also will need relief from existing legal constraints regarding forming of partnerships (contractual rules create difficulties in exchanging funds and in working with profit-making entities, the Federal Advisory Committee Act impedes informal discussions that precede development of partnerships), clarification of authorities to expend funds outside parks when those expenditures will benefit the sustaining of the park resources, and confirmation that research to assist the national science agenda is an appropriate use of parks.

NPS will address these problems through the normal budgetary process, identifying useful legislative changes, emphasizing greater development and exchange of resource information, and building on existing working models, such as those provided by the biosphere reserve cooperatives. Because of the nature of parks and the NPS park management and external assistance mission, NPS views its future role as preserver of representative natural and cultural resource elements, provider of natural and cultural resource information, and catalyst for partnership.

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DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

INTRODUCTION

Ecosystems are structurally and functionally interrelated groups of living things and their physical environment. Effective ecosystem management recognizes the importance of understanding how each of the living and non-living parts of an ecosystem contributes to, and is affected by, the health of the whole system. The scale of a managed ecosystem depends on the resources at issue, their role in the whole system, and the variety of natural and human influences affecting the system.

Resource management policy limited by arbitrary boundaries of land ownership and individual agency responsibility has limited effectiveness. Traditional resource management focused on use of single economic resources (minerals, timber, or grazing for example) or preservation of single species has led to seemingly intractable conflicts over the management of resources. Decisions based on one issue have created unanticipated and costly problems elsewhere.

Ecosystem management emphasizes natural boundaries, such as watersheds, biological communities, and physiographic provinces, and bases resource management decisions on an integrated scientific understanding of how whole ecosystems work. Ecosystem management is the tool that resource managers need for deciding how to meet multiple resource needs in their areas of jurisdiction, considering the larger scale impacts of their decisions. Ecosystem management, appropriately implemented, can help to prevent the degradation of our resources and avoid the necessity for more costly and less effective restoration and mitigation strategies.

Understanding ecosystems requires physical, chemical, biological, cultural, and economic data, along with the analytical tools necessary to integrate and interpret the data and communicate the information in a usable form to decision makers. Timely, relevant, and focused research, data collection, and effective information management are needed to fill this requirement.

ECOSYSTEM MANAGEMENT ACTIVITIES

The mission of the U.S. Geological Survey (USGS) is the timely provision of impartial, useful scientific information about the Earth for current and future generations. The USGS contributes to ecosystem management by providing data and information in two ways:

- Critical Ecosystem Research and Assessment. These short-term activities draw on long-term USGS programs and capitalize on previous investments in research and monitoring to provide a scientific basis for making management decisions in specific critical ecosystems.

- Long-term USGS research, monitoring, assessment, and data management programs. These programs are national in scope, but most are regional or local in application. They fill basic earth science data and information needs common to every ecosystem.

Within the spectrum of ecosystem management concerns in the Department of the Interior, the USGS plans to focus its Critical Ecosystem Research and Assessment activities on South Florida, San Francisco Bay and Delta, Klamath and Trinity Rivers, and Columbia River ecosystems.

South Florida

The Department of the Interior is committed to halting the deterioration of the Everglades ecosystem and to restoring, to the extent practicable, the original Kissimmee River system. Sea grass mortality in Florida Bay and the health of coral reefs have become critical ecosystem issues. The USGS, consulting with other Federal, State, Tribal, and local government agencies, identified areas where it can build on existing programs and make timely contributions of information that will facilitate critical ecosystem management decisions: (1) measure and model the movement of water in South Florida and Florida Bay to assess the availability of water for meeting the competing needs of the population, agriculture, and natural preserves; (2) assess water quality in South Florida, Florida Bay, and offshore (keys and reefs) building on ongoing programs and focusing on additional information needs such as transport mechanism for contaminants; (3) determine the natural state of South Florida and Florida Bay and offshore (keys and reefs) through paleoecology studies as a basis for assessing human influences; and (4) develop a quality assured data management system that will facilitate access to, and use of, information by all stakeholders.

Columbia River Basin

Salmon runs have declined 90 percent in the Columbia River Basin. Ongoing USGS work in the basin includes stream-flow measurement and toxic and nutrient studies in Lake Roosevelt; water quality assessments in four basins; studies of trace elements and their effect on biological productivity in Coeur d'Alene Lake; geologic mapping and identification of natural trace element deposits that could be toxic to biota; and production of digitized data bases of geology, elevation, hydrography, and other features. The USGS currently is working with the National Biological Survey, in consultation with other Federal, State, Tribal, and local government agencies, to plan the most effective ways by which they can contribute to evaluating the stresses on anadromous fish populations and to develop technically sound strategies to manage this important fishery resource.

Klamath and Trinity River Basins

The Klamath and Trinity River Basins suffer from a range of ecosystem management problems, resulting mostly from detrimental effects of human activities. Critical issues include anadromous fish declines and habitat degradation, wetland restoration, endangered fish and other species, and pesticide and fertilizer pollution. The USGS is working through existing coordinating bodies, such as the Klamath Basin Ecosystem Restoration Office, to identify and provide the critical scientific information needed now by ecosystem managers for resolving priority issues and for meeting legislative mandates for restoration of the ecosystem.

San Francisco Bay and Delta

Over the last 50 years freshwater inflow to the San Francisco Bay has declined about 60 percent because of diversion of water for agriculture and urban uses. Most wetlands are lost or degraded. Water and habitats are degraded by dredging and disposal of dredge spoils contaminated by sewage, street, and agricultural runoff. Biological communities are modified by introduced exotic species. Natural processes such as floods, droughts, and changes in oceanic circulation and sea level pose greater economic and environmental threats because of intensified human stress on the ecosystem. Fish populations are declining and increasing numbers of species are threatened or endangered. The USGS is working to increase ongoing collaboration with other Federal, State, and local agencies in multidisciplinary environmental studies that have direct application in near-term ecosystem management decisions, including water policy, wetland preservation and mitigation, sediment dredging and disposal, health and diversity of estuarine biota, and human safety.

Long-Term Programs Provide Information for Ecosystem Management

The USGS is contributing data and information for management of ecosystems nationwide through its long-term national programs. Rock, sediments, and soil form the foundations of ecosystems and hydrologic systems. Geological processes directly affect the formation, mineral content, and chemistry of soils and water. Surface and ground water are integral parts of ecosystem infrastructure. Water quality and quantity are critical in determining the health of an ecosystem. Geographic information is essential for describing ecosystems, monitoring status and trends, and evaluating changing environmental and human stresses on ecosystems.

The USGS supports broad-based geologic, hydrologic, geographic, and biological research addressing, among other things, the natural history of ecosystems and interactions between living things, land, water, and Earth processes. USGS research is improving the understanding of important ecosystem issues, including erosion, wetland loss, sediment pollution, sea-level change, and effects of increasing human stress on ecosystems. The USGS studies the effects of natural hazards, such as earthquakes, volcanic eruptions, landslides, and extreme climate events, contributing to our understanding of natural variation and change in ecosystems. USGS studies of interactions of climate, water, and terrestrial processes, as well as the natural history of climate change, emphasize the effects of climate change in sensitive ecosystems. The USGS evaluates ground water on regional scales, providing a basis for assessing ground-water systems beyond political boundaries and over entire ecosystems. There is a continuing need for improved hydrologic modeling to make decisions on water-related economic and environmental issues. The USGS National Water Quality Assessment (NAWQA) program systematically describes status and trends in the quality of the Nation's surface and ground-water resources. The NAWQA program, when fully implemented, will study sixty major river-basin and related aquifer systems throughout the United States. USGS studies are providing information needed to improve waste disposal practices and to mitigate or prevent further damage to sensitive ecosystems nationwide.

The USGS is the largest collector of water information in the United States. The National Water Information System provides access to information about the quantity and quality of water resources for the Nation. The USGS operates nationwide surface and ground-water data collection networks producing information about the availability and distribution of water resources, floods, and droughts. The National Stream Quality Accounting Network provides information about water quality and stream flow for the Nation's major rivers. The USGS operates a network of hydrologic benchmark stations to monitor changes in water quantity and quality in relatively pristine headwater areas. The USGS is the lead Federal agency for monitoring atmospheric deposition and air quality under the National Acid Precipitation Program. As such, the USGS maintains a National Trends Network, which contains 150 geographically distributed sites for monitoring the chemical composition of precipitation.

The USGS provides contemporary and historical maps including cultural, hydrographic, topographic, land use, land cover, and geologic information. It produces digital map data necessary for modeling and analyzing ecosystems using Geographic Information Systems technology. The USGS provides images of the land, including historical and contemporary aerial photography, satellite data such as Landsat and Advanced Very High Resolution Radiometer images, and Side-looking Airborne Radar data. The USGS Atlas of the Exclusive Economic Zone provides side scan sonar images depicting the physiography of the sea floor under United States jurisdiction. The USGS is developing a modern digital geologic map data base for the Nation.

USGS mineral and energy resource surveys provide information and assessments that help ecosystem managers evaluate competing demands for resources. The USGS provides worldwide information on mineral occurrences, including data useful for identifying potential sources of contamination. The USGS maintains the National Geochemical Data Base containing chemical data from soils, rocks, stream sediments, water, and plants. The USGS maintains a data system that supplies coal quality information useful in addressing air and water quality issues.

COOPERATION AND COORDINATION

The USGS has standing coordination agreements with Department of the Interior bureaus that have resource management responsibilities, as well as with the Environmental Protection Agency, the U.S. Forest Service, the National Oceanic and Atmospheric Administration, and the Soil Conservation Service.

The USGS participates in the Interagency Ecosystem Management Coordination Group, Sustainable Biosphere Initiative, Man and the Biosphere, and other groups and programs that foster cooperation, collaboration, and communication among governmental and non-governmental agencies for ecosystem management throughout the Nation and, where appropriate, internationally. The USGS was instrumental in forming the Terrestrial Research Interest Group, an informal group of Federal agency representatives who have worked together to develop a strategy for enhancing the quality and relevance of the scientific information available for ecosystem management.

The USGS Critical Ecosystem Research and Assessment program will play a key role in the Columbia River Basin, Klamath and Trinity River Basins, San Francisco Bay and Delta, and South Florida ecosystems. In order to structure a responsive program, the USGS held workshops with other Federal, State, Tribal, and local government agencies in each ecosystem, working through existing coordination groups, to learn more about critical ecosystem management issues and information needs. From the beginning, the National Biological Survey participated in planning these workshops, and they will continue to participate in program planning and implementation. As the Critical Ecosystem Research and Assessment program develops, the USGS will continue to work through existing coordination groups, consult with other agencies, and provide impartial, relevant, and timely information to ecosystem managers.

The USGS has the lead role in the Science and Assessment Strategy Team formed in the aftermath of the 1993 Mississippi flood to provide earth science information to support Federal decisions on modifications to Federal flood plain management programs that will better protect life, property, and the ecology of the Upper Mississippi River Basin.

The USGS co-founded the interagency Terrestrial Ecosystems Regional Research and Analysis Laboratory. This laboratory is an open, collaborative research facility that develops decision-oriented tools and methods for analyzing population, land, and natural resources in support of land-resource management.

The USGS, Environmental Protection Agency, National Oceanic and Atmospheric Administration, and National Biological Survey are cooperating to construct a data base of taxonomic names. The data base will allow agencies at all levels of government access to high-quality taxonomic data.

The USGS recently coordinated an interagency purchase of Landsat imagery at significant savings to the Government. These images are of interest to many agencies, including the USGS, National Biological Survey, Environmental Protection Agency, and National Oceanic and Atmospheric Administration, and are being used to develop a multi-resolution data base of land-cover information for use in ecosystem monitoring research.

The USGS Federal-State Cooperative Program is a unique, jointly funded partnership between the Federal Government and over 1000 State and local agencies to gather water data and investigate water resource problems and issues. The program is an important foundation for planning, data collection, development, and management of the Nation's water resources.

Each of the 60 studies in the National Water-Quality Assessment Program has, or is forming, a liaison committee, which consists of representatives of other Federal, State, Tribal, and local government agencies, as well as academic, professional, and other private sector stakeholders.

TOOLS OF ECOSYSTEM MANAGEMENT

The USGS is an internationally recognized expert in developing computer-based spatial data sets and automated geographic analysis tools. The USGS is participating in the development of the National Spatial Data Infrastructure under the aegis of the Federal Geographic Data Committee. The USGS's Earth Resources Observing System Data Center has been designated as the World Data Center-A for Land Remotely Sensed Data by the International Council of Scientific Unions.

The USGS provides geographic information systems (GIS)-based land use and land cover, as well as natural resource data and analyses, necessary to understand changing natural and human factors in the competition for land, water, food, and other life-sustaining or life-enhancing resources. USGS spatial data base contributions include information such as water quality and quantity, cartographic and geographic information, topography, soils, land cover (vegetation, for example), land use, geology, contaminants, and energy and mineral resources.

The USGS is collaborating with the National Biological Survey on the Gap Analysis Program by conducting research on the processing needed to create useful land cover data sets for gap research, for example clustered Landsat Thematic Mapper data. In addition USGS is producing thematic maps of land cover, land ownership, species, and Thematic Mapper images needed for the Gap Analysis Program. Statewide thematic maps currently are being produced for Utah as a demonstration project.

FUNDING ECOSYSTEM MANAGEMENT

The President's budget for FY 1995 establishes a new USGS Budget Activity--Critical Ecosystems Research and Assessment--that focuses directly on priority ecosystem management issues. The general budget structure accommodates flexibility in ongoing USGS research, monitoring, assessment, and data management programs that contribute to ecosystem management. Initially, focused ecosystem research and assessments can be accomplished by either temporary or permanent reallocation of budget and personnel resources. Further expansion of focused ecosystem programs under current constraints would be at the expense of essential contributing national environmental programs.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

The USGS aspires to continue its role as an expert and effective provider of impartial earth science data and information needed for ecosystem management. The mission of the bureau, its expertise, and enabling legislation subsume this continued role. A challenge to the USGS will be to meet changing national priorities and expanded national needs for data and information to support ecosystem management within the context of investment in research, development, and information infrastructure. The USGS hopes to meet this challenge through the flexibility of its workforce, expanded partnerships with other agencies, and cooperative programs with the States and Indian Nations.

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ENVIRONMENTAL PROTECTION AGENCY

ECOSYSTEM MANAGEMENT ACTIVITIES

The Environmental Protection Agency (EPA) can protect and restore ecosystems by reducing pollution and other stresses while also addressing socioeconomic needs on a sustainable basis. By complementing existing programs with an expanded focus on ecosystems and landscapes, EPA can provide better protection for public health and the environment nationwide.

EPA has both the legislative authorization and expertise to play a significant role in Federal ecosystem efforts. The agency's governing statutes authorize the protection of ecosystems for many different types of resources throughout the country. For example, the agency actively protects a variety of aquatic habitats such as wetlands, lakes, rivers, and streams through the Clean Water Act. The agency also reduces risks to habitats through its authority to regulate chemicals or wastes. The agency's non-regulatory programs provide grants and incentives that can be directed toward improving ecosystems. EPA research is contributing to ecological risk assessment and risk management methods, landscape ecology, improved understanding of ecological condition, and better data on ecosystem status and trends. Moreover, EPA is building up its level of coordination with other agencies in the area of information management and data sharing. This is best typified by EPA's Environmental Monitoring and Assessment Program (EMAP) which is designed to determine the status and trends of ecosystem conditions. In preliminary discussions with other Federal agencies, it is clear that they view EPA as an important ally in ecosystem protection.

EPA's challenge will be to integrate ecosystem management concepts into all agency operations, and to forge working alliances among Federal agencies, States, tribes and other parties involved in ecosystem and biodiversity issues. Currently an Ecosystem Protection Workgroup led by three Assistant Administrators is developing recommendations for changes to EPA programs, policies, and institutional structure. The workgroup will also ask the EPA regions and States to select demonstration projects that will help protect and restore the Nation's ecosystems by refocusing the agency's activities from programs to places.

Two steps must occur if ecosystem protection is to be integrated into the agency's work. The first is to broaden the agency's efforts to be more cross-media and integrated with an emphasis on ecosystem-level problem solving. The second step is to focus on specific ecosystems upon which the agency's resources can be more effectively directed to achieve area-specific environmental goals. The goal of the agency's ecosystem protection efforts will be to maintain overall ecological integrity of the environment while ensuring that ecosystem outputs meet human needs on a sustainable basis.

While the agency is currently working to more fully integrate ecosystem protection into its operations, various EPA programs and regional offices have already begun to move toward an ecosystem protection approach in specific geographic areas. These activities are too numerous to describe fully here, however several examples from program and regional offices are provided below.

Office of Research and Development (ORD)

Because ecosystems are affected by multiple, interacting chemicals and many other non-chemical stresses, the agency needs a better understanding of the stresses on all the components in a system. Unfortunately, a holistic approach has not yet been well developed. Consequently, the Office of Research and Development is reorganizing its ecological research program to focus on developing the capability to do risk assessments for ecosystems. By studying the interactions among the water, atmospheric, and land systems in a geographic area, the agency can best contribute to risk reduction strategies for ecosystems.

One example of ORD's ongoing efforts is EMAP, a national scale monitoring program developed to determine the status and trends of the nation's ecosystems. When fully implemented through cooperation with other agencies that share resource monitoring responsibilities, this research and monitoring effort will provide the needed information to document the current condition of our ecological resources, understand why that condition exists, and predict what conditions will exist in the future under various management alternatives. Such information will enable EPA to take steps that will minimize future risk or to revise current efforts that fall short of their intended results.

ORD Laboratories also support ecological protection. One example of work being done is the "Ecosystem Management Research in the Pacific Northwest" effort by EPA's Corvallis Lab. The research proposed is a part of the multi-agency initiative to implement ecosystem management in the Pacific Northwest. The research program is designed to complement research planned by other Federal agencies within the region and will focus on multiple-use, multiple-ownership lands.

Office of Water

The Office of Water is planning and managing water quality and water resources on a watershed basis using ecosystem principles. The framework for this effort is the Watershed Approach which is an integrated, holistic strategy for more effectively restoring and protecting aquatic ecosystems and protecting human health. Another example of the Office of Water's contribution to ecosystem protection is the continuing work to develop biological criteria. In addition, several water quality research issues will be consolidated into an ecosystem protection research cluster in FY 1995. This will provide the scientific basis for sustainable management and protection of ecological systems in specific watershed areas.

Office of Administration and Resources Management (OARM)

The Office of Administration and Resources Management will be focusing on providing tools and infrastructure required to implement ecosystem protection. OARM will assist in the removal of institutional barriers to implement ecosystem protection in the budget, information systems, organizational structures, and assistance programs.

Office of Enforcement and Compliance Assurance (OECA)

Strategic enforcement of existing Federal pollution standards should be a major component of EPA's ecosystem protection effort. The primary function of OECA's Agriculture and Ecosystems Division will be to identify environmental impacts and activities in critical ecosystems in order to ensure efficient and coordinated enforcement responses. One specific enforcement project will develop a process to target areas that are adversely affected by facilities that are in noncompliance with environmental laws. The use of the National Environmental Policy Act and EPA's responsibilities to review the actions of other agencies are important elements of ecosystem protection.

Great Lakes National Program Office

The Great Lakes Program is a nested structure of activities, managed and implemented by an alliance of State, Provincial, Federal, tribal, and non-governmental agencies. This nested structure is meant to parallel the natural hierarchies and boundaries found in the Great Lakes ecosystems; from local landscapes to sub-watersheds to individual lake basins to the entire Great Lakes basin and beyond.

Great Lakes Program actions are coordinated under a 5-Year Strategic Plan. The agencies and organizations involved are working in partnership to address a range of environmental issues, including: the promulgation of water quality criteria and implementation procedures tailored specifically for the Great Lakes Basin; inventorying and protecting critical and important habitat throughout the Basin that supports the region's outstanding biological diversity; demonstrating state-of-the-art assessment and clean-up technologies to remediate contaminated sediment; conducting the most extensive monitoring and modeling evaluation of toxic substances ever undertaken to evaluate pollutant loads, transport, and fate in the Lake Michigan watershed; and pioneering the development and implementation of an integrated information management system to support ecosystem management at the State and Federal level.

Chesapeake Bay Program Office

The Chesapeake Bay program is a multi-governmental partnership which includes the States of Pennsylvania, Maryland, and Virginia; Washington, D.C.; the Chesapeake Bay Commission, a tri-State legislative body; and EPA representing the Federal government. The Chesapeake Bay Program has been directing and conducting the Chesapeake Bay restoration since 1983. More than half of EPA's $21 million Chesapeake Bay Program budget is given to the States in the form of implementation grants for on-the-ground projects to fulfill the goals and commitments of the Program partners. Bay Program efforts are multi-media, cross-program, inter-governmental, and involve a diverse array of stakeholders. The Program has concentrated on enhancing the living resources of the Bay through habitat restoration projects, nutrient reduction activities from point, non-point, and air deposition sources, and has recently moved its focus upstream into the watershed's tributaries.

Office of Solid Waste and Emergency Response

Funding through this office is targeted to States to address waste management's contribution to environmental protection in sensitive ecosystems such as the Great Lakes, Gulf of Mexico, Chesapeake Bay, and the Caribbean. Activities that support ecosystem protection include: ecological assessment guidance and planning, pilot cleanup projects to stimulate redevelopment in contaminated urban areas, and policies to integrate Federal facility activities into ecosystem protection.

Region 1 - Maine, Vermont, Hew Hampshire, Rhode Island, Connecticut, and Massachusetts

Region 1's Resource Protection Strategy entails developing management measures to protect high priority natural resources in New England and integrating its work with ecosystem management principles. Working with New Hampshire as a pilot State, Region 1 is developing a process to be used in all New England States to identify and protect priority resources. Support for this project comes from State, Federal, and local agencies, environmental groups, and other organizations. The purpose of this work is to ensure that limited financial and staff resources are spent where they are most needed. The first step is to develop criteria for selecting the highest priority resources in the State. The second step will be to ensure that adequate measures are in place to protect these resources.

Region 2 - New York, New Jersey, Virgin Islands, and Puerto Rico

Region 2 is working with stakeholders to develop comprehensive plans to restore the ecological integrity of the Niagara River, Lake Ontario, Long Island Sound, New York/New Jersey Harbor, New York Bight, Delaware Estuary, and San Juan Bay. The Region is also preparing, in cooperation with the Corps of Engineers, an environmental impact statement covering land use planning and environmental protection in the Hackensack Meadowlands District in northwest New Jersey.

Region 3 - Pennsylvania, Maryland, the District of Columbia, West Virginia, Delaware, and Virginia

Two ecosystem related projects highlight Region 3's efforts. The first is the Mid-Atlantic Highlands Assessment which will evaluate the condition of more than half of Region 3's natural resources. The effort will support improved planning by States and the divisions of Region 3. The assessment combines a number of complex State, regional, and national environmental monitoring designs into an assessment process. When fully developed, the assessment will provide the tools to integrate land cover information, measures of human-caused environmental stress, and the biological assessment of stream and fish communities, and agricultural and forest ecosystems. These integrated assessment tools permit improved environmental management by focusing programmatic and technical tools on key problems.

The second project is the Poconos Habitat Demonstration project. A part of Region 3's Terrestrial Ecosystem Protection Initiative, this project will identify ecosystem goals and action plans for two watersheds in Monroe County, PA. Federal, State, and community groups are involved in planning, research, and implementation of actions to meet the identified goals.

Region 5 - Minnesota, Michigan, Illinois, Indiana, Ohio, and Wisconsin

The oak savannas and open woodlands of the Midwest are among the country's most threatened communities. Region 5, along with The Nature Conservancy and two universities, hosted a conference in 1993 that developed a recovery plan for these rare ecosystems. The region is continuing to work with many partners to revise the recovery plan and to identify critical sites for protection and restoration. In addition, Region 5 established an Environmental Roundtable in 1991 to engage Federal, State, and non-governmental organization partners in cooperative ecosystem protection.

Region 7 - Iowa, Nebraska, Kansas, and Missouri

Region 7's Great Plains Project is a cooperative ecosystem effort with the Western Governor's Association, Mexican Border Governors, the Departments of Agriculture and the Interior, and other public and private groups. The overall goal of this initiative is to select areas of high biological value in the Great Plains region; assess the health of the ecosystems within several of these areas; and develop a range of management tools to integrate economic and environmental needs. Three specific objectives of the project are to compile available scientific knowledge and information on the ecological structure of the Great Plains region; determine areas of high priority for protection, enhancement, or preservation based on existing quality of habitat and threats from various factors; and provide this information in a geographic information systems (GIS) format for decisionmaking throughout the Great Plains.

Region 9 - California, Nevada, Arizona, and Hawaii

Region 9's San Francisco Bay/Delta Estuary Initiative is a long-term geographic initiative that focuses on protecting and restoring the estuary's waters, wetlands, and aquatic ecosystems by informing and involving the public, agricultural, and regulated communities. The initiative emphasizes Region 9's commitment to ecosystem protection, pollution prevention, forming partnerships with Federal and State counterparts, coordination with other projects, improving EPA's science and technical capabilities, and fostering cross-media integration.

Region 10 - Washington, Oregon, Alaska, and Idaho

Region 10 continues its work for planning and implementing the Northwest Forest Plan. Region 10 staff participate on Federal interagency teams that address scientific assessment, environmental impact statement preparation, public comment analysis, air quality assessment, overall implementation, monitoring, restoration, watershed analysis, geographic information systems, and community economic assistance. EPA will strive to increase participation of State and private landowners and reinforce the commitment to monitoring and adaptive management.

EPA's most direct jurisdiction responsibility regarding wildlife involves water quality criteria, standards, and management program designed to protect aquatic life. EPA Region 10 has adopted a Watershed Protection Approach to recognize the need to expand EPA's traditional focus to include a broader array of ecological stressors and to involve the range of stakeholders within a watershed. This approach is consistent with the goals of the Office of Water. Region 10 proposes to encourage and facilitate State and local efforts to manage on a watershed basis, target technical tools, funding, and expertise to watersheds where pollution and habitat destruction pose the greatest risk to human health or ecological resources, and build stronger alliances among the many stakeholders within a watershed.

COOPERATION AND COORDINATION

Many of the projects and activities described above are being done in collaboration with Federal and State agencies, and reflect how EPA works with these other agencies. EPA recognizes the importance of working with other agencies to achieve ecosystem management. Accordingly, the agency will strive to increase coordination and collaboration among Federal, State, tribal and private organizations.

EPA is involved in many coordination efforts with our Federal partners. The Assistant Administrator for Policy, Planning, and Evaluation, for instance, is EPA's representative on the Interagency Ecosystem Task Force chaired by the Director of the Office on Environmental Policy at the White House. Another strong example of EPA's efforts is a workshop on EPA's ecosystem protection efforts sponsored by the Environmental Law Institute that brought together 20

Federal agencies. The report generated at the workshop outlined many useful suggestions for EPA's ecosystem protection efforts and for opportunities for interagency coordination and cooperation. EPA was also instrumental in bringing together Federal, State, and local agencies, the private sector, and the public in a conference held in March, 1993 to exchange ideas and information concerning comprehensive watershed management.

EPA ecosystem protection efforts will benefit greatly from increased interaction with other Federal agencies. For example, the Interagency Ecosystem Management Coordination Group was formed to promote coordination and collaboration of ecosystem management activities among diverse agencies. EPA staff assisted in the formation of the group and continues to work with other agencies in its many functions. EPA will continue to profit from the group's network of agencies, and others, as it works on ecosystem management related issues.

TOOLS OF ECOSYSTEM MANAGEMENT

Efforts to protect the environment are inherently geographic in nature. Achieving an informed understanding of the often complex relationship between natural resources, human population, and pollution sources is critical to successfully accomplishing the mission of the EPA.

The agency is one of the largest consumers of spatial data in the civilian government. In an effort to maximize the use of this information, the Office of Information Resources Management (OIRM), established a National Geographic Information Systems (GIS) Program in 1989, to manage, coordinate and promote EPA's integrated use of spatial data. While the primary leadership role rests within OIRM, the Regional, Laboratory, and Program Offices GIS teams serve as the key reference point for EPA's spatial application development and program support. This agency-wide infrastructure includes: 10 regional offices; 7 laboratories; the Center of Excellence for Applied Research and Development in Las Vegas, NV; the Environmental Monitoring and Assessment Program (EMAP); the National Data Processing Division in Research Triangle Park, NC; and Headquarters program offices.

The National GIS Program in OIRM was established to provide both leadership and support to the agency decision-makers and program offices. The GIS Program is responsible for developing and maintaining an agency-wide support network; participating in the review and evaluation of new GIS related technologies; promoting the sharing of GIS data and expertise; coordinating with external organizations concerning GIS and related geographic data activities; and serving as a focal point for GIS issues within the agency.

The GIS Program has been actively involved with the development and implementation of the EPA Locational Data Policy, which requires that environmental monitoring data EPA collects include a latitude-longitude coordinate of know accuracy; the National Spatial Data Management Plan, which addresses the best way to deliver these data across the agency; and a member of the Federal Geographic Data Committee, in the development, implementation, and support of the National Spatial Data Infrastructure.

FUNDING ECOSYSTEM MANAGEMENT

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

(EPA chose not to discuss these two topics in their report.)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ECOSYSTEM MANAGEMENT ACTIVITIES

The National Aeronautics and Space Administration (NASA) does not engage in ecosystem management in the strictest sense. NASA does manage the lands incorporated within the 9 NASA Centers throughout the U.S. There is no broad policy or mission statement concerning ecosystem management. Programs and policies, for the most part, are developed by the individual field centers. NASA also conducts both basic and applied research relevant to ecosystem management. This research is directed toward understanding ecosystem processes, monitoring land cover, and understanding the impacts of NASA land usage (e.g., launches and testing of aerospace equipment) on their surrounding ecosystems.

NASA is committed to managing the ecosystems within its NASA field center properties in a responsible and sustainable fashion. While all field centers are concerned with the impacts of their activities on the environment, the greatest opportunities for ecosystem management lie at Kennedy Space Center (KSC), Stennis Space Center (SSC), and Wallops Flight Facility (WFF). Within the boundaries of KSC are the greatest number of different threatened and endangered species located on any Federal property. The undeveloped portions of KSC are managed by the U.S. Fish and Wildlife Service (FWS) as the Merritt Island National Wildlife Refuge. KSC supports the FWS efforts through field sampling and other data collected by NASA environmental contractors. NASA also ensures that KSC's activities are coordinated with the Canaveral National Seashore that is administered by the National Park Service (NPS). SSC has undertaken an important program attempting to upgrade the quality of certain of its wetland areas. WFF has been working with FWS and NPS to preserve habitat for endangered species and restrict access and activities during sensitive periods of the year.

In its Mission to Planet Earth (MTPE) research program, satellite-based observations of Earth surface ecosystems are used to study the areal extent and condition of ecosystems as well as to estimate land cover change over the time period of the historical satellite data record. These spatially extensive observations of what is actually there and of how it has changed over recent times can be enormously helpful to resource managers who may otherwise have difficulty in obtaining such extensive, internally consistent, repeatable data for their ecosystems. Process studies also are conducted under the MTPE program to understand the environmental controls on ecosystem function, both in relatively undisturbed ecosystems and in those impacted by human activities. This process understanding is then available to land managers and decision makers as a basis for formulating ecosystem management strategies. This process understanding and the satellite-derived information on surface ecosystems also can be used by modelers to predict how ecosystems might respond to change. NASA and other agencies are supporting such modeling studies now, but predictive modeling of ecosystem function and change is challenging, and progress will depend on the depth of our understanding of key ecological processes and other modeling refinements.

The MTPE program is developing a series of satellites to carry Earth remote sensing instruments that will not only advance the U.S. Global Change Research Program's goals and objectives centered around developing a predictive understanding of how the Earth functions as a system, but also provide the next generation of satellite observations for resource and ecosystem managers. They will provide continuity with past satellite data sets while improving data quality and calibration and will also offer completely new types of observations.

The Earth Observing System (EOS), a series of Earth Probe missions, and many partnerships with foreign satellite programs (in particular those of Europe, Japan, Canada, and Russia) are part of the overall MTPE observational strategy. The EOS Data and Information System (EOSDIS) will manage the data resulting from these Earth science research satellites, field measurement programs, and other data essential for the interpretation of their measurements. EOSDIS is NASA's contribution to an international global change information system. Its focus will be on acquiring and archiving data, distributing it to users, producing user-defined data products, achieving connectivity with other global change data systems and archives, and encouraging interdisciplinary research. EOSDIS data and analysis tools and capabilities will be of value for ecosystem management, and support for a broad base of such external users is part of the core plan for EOSDIS.

COOPERATION AND COORDINATION

NASA cooperates with Federal, State, and local agencies in managing its NASA field center properties. At KSC and WFF, this involves close coordination with the FWS, NPS, and a variety of local agencies to protect wildlife and preserve habitat for threatened and endangered species. Before undertaking construction or new activities, NASA routinely consults with Federal, State, and local agencies concerning the environmental implications of such proposals and potential mitigation. Use of State clearinghouses has proved to be an important tool.

NASA coordinates its ecosystem management related research with other Federal agencies through the U.S. Global Change Research Program, which is organized by the Office of Science and Technology Policy (OSTP) sponsored Committee on Environment and Natural Resources (CENR). Individual projects may be jointly funded, such as the Landsat Pathfinder program to produce a global assessment of forest/non-forest cover for the moist tropics; the Environmental Protection Agency and the U.S. Geological Survey are key partners in this endeavor. Major field campaigns to understand ecological processes, such a the Boreal Ecosystem-Atmosphere Study (BOREAS) and the Joint Global Ocean Flux Study (JGOFS) almost always involve multi-agency partnerships and the sharing of resources (including aircraft, ships, other unique and valuable equipment, field study sites, and personnel -- in addition to funds).

NASA participates in a variety of interagency coordinating groups that address issues relevant to ecosystem management. As an example, NASA participates in the Man and the Biosphere Program led by the U.S. Department of State; this program sponsors research and integrative, synthetic activities that assess human's role in the environment and focus on studying ecosystem sustainability.

NASA has been actively participating in the Interagency Ecosystem Management Coordination Team for about six months. Already this group is providing a forum for information exchange and clarifying interagency thinking about ecosystem management issues and needs. NASA's continued participation in this coordination team will be important so that NASA can keep its surface cover monitoring activities and process studies aligned with the interests and needs of the Federal agencies that have far more significant ecosystem management responsibilities than does NASA.

TOOLS OF ECOSYSTEM MANAGEMENT

NASA has considerable experience with a wide variety of spatial data analysis tools. The use of remotely sensed data has required such tools, and over the years NASA has played a strong role in their development and implementation. In addition to this research and development role, most of the NASA field centers have implemented geographic information systems (GIS) for their site. They are endeavoring to use GIS in managing the sites in order to minimize impacts on the environment.

NASA's Information Systems Office continues to play leadership role in exploring new approaches and more sophisticated techniques for image analysis, pattern recognition, increased automation, expert systems, and modeling aids. The EOSDIS now under development will be a comprehensive and integrative data and information system to capture, correct and calibrate, document, archive, and distribute Mission to Planet Earth data sets. GIS techniques and other spatial data handling tools will be essential tools for EOSDIS.

FUNDING ECOSYSTEM MANAGEMENT

Management of the NASA field center properties falls under their overall operational budgets. Special studies are funded out of the responsible program office's or NASA center's budget, as needed. NASA does not believe budget restructuring will be required to accommodate ecosystem management at its field center sites.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

NASA does not believe there are any serious staffing or legal restrictions that constrain its ability to manage the NASA field center properties or to conduct research relevant to ecosystem management.

In the recent past there have been constraints related to the sharing of commercial data sets for operational uses. Many of these constraints have been successfully alleviated, but the situation has been dynamic and could continue to be so. For example, NASA is just beginning to explore the possibility of developing a global land cover data set at fine spatial resolution (perhaps as a follow-on to the Landsat Pathfinder or as a separate activity) for global change research purposes. It is clear that such a data set (or sets) would address the needs of land and ecosystem managers as well as research scientists for a wide variety of applications. Policies are now in place to make Landsat data available for non-commercial purposes and sharing among a large user group at a reasonable cost. However, if data from the French SPOT, European Space Agency's ERS-1/2, Canada's RADARSAT, or Japan's JERS-1 or ADEOS satellites were to be used, special negotiations for applied use and expanded data sharing would probably be required (current agreements only cover research use) -- probably involving additional costs to the U.S. Federal Government. For coastal ecosystems, policies are in place only for research use of SeaWiFS data. It is possible that coastal ecosystem management activities that would benefit from SeaWiFS data becoming available might not be able to share data sets created for research purposes.

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NATIONAL SCIENCE FOUNDATION

ECOSYSTEM MANAGEMENT ACTIVITIES

Ecosystem management is a management decision system utilizing the synthesis of scientific disciplines including ecology, economics, wildlife management, forestry, geology and geography applied over a wide range of spaciotemporal scales. Fundamentally, ecosystem management is an integrative approach to the maintenance of land and water resources as functional habitat for an array of organisms and the provision of goods and services to society. Hence, the objective of ecosystem management is to sustain biodiversity while providing vital social and economic systems. We also could define ecosystem management as "human management", the management of human use and manipulation of the environment.

The National Science Foundation (NSF) supports fundamental research that is critical to managing ecosystems. As a component of this mission, the NSF has been involved in research on ecosystem management for over 30 years and on the components that we currently recognize as parts of modern ecosystem management since its inception. In the 1960's, the NSF supported early ecosystem studies by Eugene Odum on disturbances to the southeastern wetlands and by Frank Bormann and Gene Likens on the impacts of clear-cutting on forest ecosystems in the Northeastern US. This emphasis continued through the International Biome Program of the late 1960's and early 1970's funded through the NSF in which the interacting forces that regulated the functioning of ecosystems were studied.

Today, the NSF is involved in supporting a wide array of studies on ecosystem dynamics and the services that ecosystems provide in cooperation with other Federal agencies, the Nation's universities, and many private and local entities. The NSF supports a wide array of innovative ideas that come from the Nation's foremost resource, its citizens, to assess the physical/chemical constraints on ecosystem processes, the biotic compositions of differing ecosystems, the interactions amongst ecosystem components, and how all of these components come together to provide the vast array of services that ecosystems provide to humans. Below we list some of the projects and topics that are supported by the NSF. Please remember that these are only a limited number of the outstanding research efforts underway.

Baseline Surveys

In order to manage ecosystems, many types of baseline data are needed. At the NSF, we are supporting basic studies designed to produce baseline information that can be utilized to formulate management strategies.

Ecosystem Diversity and Habitat Descriptions

Numerous projects are underway that are studying relationships between organisms and their environments, especially for ecosystems that we have little understanding of. For example, the Antarctic dry valleys were viewed as an analog for Mars because of the harsh conditions. However, researchers have demonstrated that organic matter produced in the oceans and in the many glacial ponds blow onto the land and provide the resources for complete food webs for a wide variety of microorganisms and animals.

Basic systematic relationships

The NSF supports basic research on taxonomic relationships among organisms that comprise all ecosystems, both natural and managed.

Taxa Descriptions of Lesser-Known But Important Biological Groups

Surveys are ongoing that are attempting to describe many groups of organisms that are important as tools for biotechnology and are crucial for the functioning of ecosystems. For example, there are many fungi known as truffles that form symbiotic associations with trees. These fungi are required for growth by the trees and also are a major food item for many small mammals that are, in turn, food for many birds such as the spotted owl.

Development of Techniques to Assess Larger Scales Than Single Communities or Watersheds

Although satellite imagery is available to produce images of the earth, understanding what the signals mean and gleaning important information from the tremendous amount of satellite data is a daunting task. Researchers supported by the NSF have pioneered the theory and use of geographic information systems (GIS) and other computer tools for assessing ecosystem structure. New computer models and analytical methods are being developed to integrate information gathered at a variety of scales to describe the characteristics of ecosystems and to understand how organisms move and utilize resources across ecosystem boundaries.

Long-Term Data Sets That Describe Biotic Conditions

The present conditions often are the result of the history of changes that have occurred in the past. Long term studies supported by the NSF are critical to understanding both the current conditions and the dynamics of ecosystems.

Resources for Biotechnology

Genetic engineering is an important industry in the US. However, traits important for the biotechnology industry are not created in an engineering sense but are found in nature and transferred to organisms or conditions in which they are most useful for humans. Baseline information is being gathered in which interesting or novel drugs or other products are found in existing ecosystems.

Defining Structure-Function Relationships of Ecosystems

In order to properly manage ecosystems, the relationships between organisms and land/sea-scapes need to be understood. Examples are:

- Sources of trace gases that influence our environment. It is crucial that natural sources and rates be understood in order to know how humans are changing these quantities.
- The importance of keystone organisms such as oysters and kangaroo rats that appear to regulate the composition of their surrounding communities and dictate the rates of nutrient cycling.
- The importance of the diversity of organisms in ecosystems and the role of biodiversity. Research has demonstrated that during years of stress, subordinate organisms are often crucial to maintain productivity of ecosystems.

Assessments of Perturbations

Both human and natural disturbances have the ability to profoundly alter the dynamics of ecosystems that influence management decisions. Examples are:

- The effects of the large California wildfires on the recovery or lack of recovery of the vegetative communities that comprise these wildlands and how the recovery pattern influences the stability of these slopes.
- Arctic ecosystems are shifting from net importers of CO2 to net exporters of CO2 further exacerbating the CO2 greenhouse effect.
- Large atmospheric inputs of nitrogen from agricultural and automotive sources are causing ecosystems to change and be controlled by other factors than nitrogen. This often leads to a competitive advantage by weedy species allowing invasions into native areas.

Historical/Prehistoric Influences That Determine Current Ecosystems

We often assume that the ecosystems that we manage are the result of some stabilized permanent conditions. However, both historical and prehistoric conditions have often dictated that ecosystems are structured in their current form. For example:

- Native Americans utilized the forests in several ways that resulted in the open forests that occurred at the turn of the century. Without their influence, the forests of today are less productive and support a lower diversity of wildlife.

- Farmland clearing in the late 18th and early 19th centuries has left a legacy in their trace gas emissions even though the entire area today is contiguous forest.

Special Programs

LTER/LMER

There are three programs at the NSF that are uniquely capable of providing information useful to ecosystem managers. The Long-Term Ecological Research (LTER) program consolidates an extended temporal outlook over a wide variety of ecosystems. The Land-Margin Ecosystem Research (LMER) program provides specialized information at the interface of our coastal lands, wetlands, and oceans. The Conservation and Restoration Biology (CRB) Program provides fundamental information crucial to protecting and restoring critical biological and ecological resources.

The LTER and LMER programs are especially important for ecosystem management. A long-term research outlook is crucial for evaluating the full spectrum of ecosystem functions and changes. Extended time frames are more apt to capture rare or episodic events like floods, volcanic eruptions and spectacular, ephemeral vegetation dynamics. The LTER program's 18 research sites from Alaska to Antarctica with 600 collaborating scientists and students of various disciplines spans a wide variety of ecosystems and their functions. Represented in this set, for example, are temperate coniferous and deciduous forests, Arctic tundra and Antarctic desert, tall grass prairie and row-crop agriculture.

Even though the LTER program crosses over extremely diverse ecosystems there is a common thread of basic ecological research. Scientists at each site ask similar questions with regard to successional change, population dynamics, landscape patterns, nutrient cycling, productivity and natural and human disturbance. Many utilize shared datasets, satellite imagery and geographic information systems (GIS) to achieve a synthesis across a network of sites, an effort which is growing to include international activities.

Ecosystem management espouses the ability to provide quality habitat as well as goods and services to society. Research at the H.J. Andrews Experimental Forest LTER site has provided specific examples of how retaining forest structure as part of the harvest system has a positive effect on habitat quality and long-term forest site productivity. Work at the Cedar Creek Natural History Area LTER site illustrated how the biodiversity of plant life is an asset in the face of catastrophic events such as drought. Research topics at the Kellogg Biological Station LTER site include productivity and environmental impact of production level cropping systems. Not all research is focused on terrestrial systems. 12 LTER sites engage in stream research which elucidates geomorphologic processes, aquatic and riparian ecosystem functions, and response to disturbance. Data from stream chemistry research at the Coweeta Hydrological Laboratory LTER site has been instrumental in the modification of forest management practices in the region. Palmer Station, the LTER Antarctic marine site, investigates open-water polar marine food webs and habitats.

Assessing the veracity and validity of ecosystem management in achieving the goals society sets will be dependent on feedback from monitoring. LTER and LMER sites in representative ecosystems with their long-term outlook can provide the necessary controls for assessing the effectiveness of ecosystem management.

Conservation/Restoration Biology

A special program at the NSF is the CRB program in which the special problems of protecting endangered ecosystems and restoring destroyed ecosystems are addressed. A wide array of projects are being undertaken. As ecosystems are managed for differing resources, such as timber, the resulting changes in ecosystem structure can serve as a bottleneck on populations. For example, habitat fragmentation affects the genetic diversity of residual populations.

The restoration of destroyed ecosystems is a critical research need. Putting viable ecosystems back together requires a better understanding of both fundamental concepts of ecosystem dynamics and careful incorporation of management practices. The NSF has supported several important projects studying the restoration of disturbed lands. These include understanding the limiting stages in succession in a restored strip mine, assessing the importance of planting diversity in tropical forest plantations, and assessing the size and distance relationships of restored areas to existing native patches of plants and pollinators.

COORDINATION AND COOPERATION

The NSF commonly cooperates with other agencies through the funding of fundamental research. The primary example is the interaction with other agencies on the LTER and LMER sites. Most of the sites are on Federal research stations (e.g., Forest Service Experiment Stations, Agricultural Research Stations, National Wildlife Refuges). Academic research is integrated with Federal research on these sites for a more complete understanding of the biodiversity and ecosystem dynamics required for ecosystem management. Some of the sites are owned privately (e.g., Harvard University) or by non-governmental organizations (e.g., The Nature Conservancy) resulting in coordination among academic, private and Federal research.

TOOLS OF ECOSYSTEM MANAGEMENT

GIS are common tools in many of the environmental disciplines of academic research. The LTER sites have excellent GIS and GPS capabilities including the electronic transfer of spatial data across the network for cross-site comparison and analysis. The GIS system of choice is ARC/INFO.

FUNDING ECOSYSTEM MANAGEMENT

The NSF does not perform ecosystem management as a part of its mission. The budget for fundamental research on biodiversity and ecosystem dynamics, which are important to ecosystem management, is an important priority in the Biological Sciences Directorate and will influence future funding priorities.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

The role of fundamental research supported by NSF on ecosystem management can be enhanced in many ways. Current plans, for example, to augment the LTER program to allow expansion to regional scales and include more social and economic science will improve the opportunities for extrapolating the results of fundamental science to natural resource use and social welfare. Adding more LTER and LMER sites also is important to understand additional types of habitats, situations, etc., and provide a better knowledge base for the entire continent. Additional interactions with the research programs and research sites of other agencies is necessary. NSF is attempting to work with other agencies to develop a network of networks; linking the many research stations and sites together in a way that allows for information exchange, sharing of expertise, and broad-scale analyses and syntheses of research important to the management of ecosystems.

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FUNDING ECOSYSTEM MANAGEMENT

The NSF does not perform ecosystem management as a part of its mission. The budget for fundamental research on biodiversity and ecosystem dynamics, which are important to ecosystem management, is an important priority in the Biological Sciences Directorate and will influence future funding priorities.

ECOSYSTEM MANAGEMENT LIMITS AND OPPORTUNITIES

The role of fundamental research supported by NSF on ecosystem management can be enhanced in many ways. Current plans, for example, to augment the LTER program to allow expansion to regional scales and include more social and economic science will improve the opportunities for extrapolating the results of fundamental science to natural resource, policy and social science. Adding more LTER and LMER sites also is important to understand additional types of habitats, situations, etc. and provide a better knowledge base for the entire continent. Additional interactions with the research programs and research sites of other agencies is necessary. NSF is attempting to work with other agencies to develop a network of networks linking the many research stations and sites together in a way that allows for information exchange, sharing of expertise, and broad-scale analyses and synthesis of research important to the management of ecosystems.

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